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Discount Formulas in the Valuation of Wasting Assets, by John A. Church, Jr.

A Journey to South Africa—VI, by T. A. Rickard

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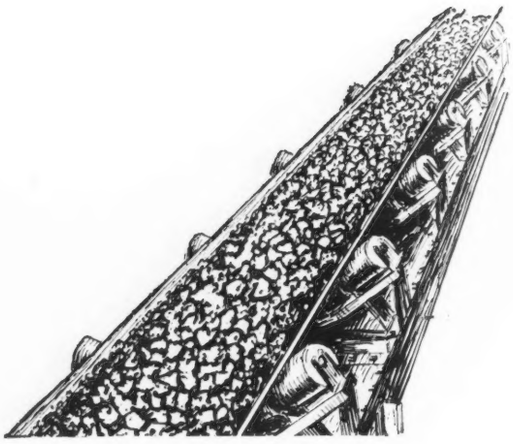

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Volume 121 New York, January 2, 1926 *Number* 1

ENGINEERING AND MINING JOURNAL-PRESS

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Contents

*Illustrated Article

Editorials	1
*Vieille-Montagne: A Pioneer in Zinc Industry By Gaston Saint-Paul de Sinçay	4
*Discount Formulas in Valuation of Wasting Assets By John A. Church, Jr.	8
*A Journey to South Africa—VI By T. A. Rickard	13
Consultation	22
Mining News	23
Societies, Addresses and Reports	30
Recent Technical Publications	32
Men You Should Know About—Obituaries	33
New Machinery	34
Markets	36
Company Reports	38
Mining Stocks	40

Searchlight Section	30-32
Professional Directory	33
What and Where to Buy	36
Advertising Index	40

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ENGINEERING AND
MINING JOURNAL-PRESS

JOSIAH EDWARD SPURR, Editor

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Soviet Russia and Mining

THAT Soviet Russia is not yet an attractive place for mining investment is the opinion of Leslie Urquhart, chairman of the Russo-Asiatic Consolidated, Limited. For some time negotiations have been going on between this company and the Russian government, with a view to reopening the extensive mines of copper, lead, zinc, and coal in South Russia and Siberia. The Soviet government, having confiscated the company's properties, but finding itself unable to operate them, now demands that the company advance £2,000,000 to put these properties in working order, in return for which the company is granted a leasehold. All standing claims against the Soviet government must be signed away. This, the company concludes, is reason enough for not throwing good money after bad at the present time, although it sees a gradual swing of the Russian political pendulum, under economic stress, toward a more favorable and liberal attitude. The Soviet government, it is observed, has hitherto labored under the delusion that it can borrow money from those nations the property of whose citizens it has confiscated; but, this belief having gradually evaporated, the time is looked forward to when Russia will adopt the moral and financial codes of the world, so far as it finds itself forced into that position. As this tendency increases, mining operations involving substantial investments will be more and more favorably considered in England and America.

Topographic Survey of the United States

THE TOPOGRAPHIC MAPS of the United States which are being made by the U. S. Geological Survey are universally recognized and praised as the best and most useful type of maps possible. They are adapted to the use of all engineers, and are by them used as a basis for all engineering plans in the first stage, whether the engineer be of the mining or civil type, or has to do with irrigation or power plans. But they are used and appreciated by other people as well; indeed, they constitute one output of government engineering which is highly popular. The only criticism which is voiced is that the list of maps is not complete. In a given section the maps of certain rectangular areas are available: but near-by and not less important areas are missing. The reason is of course that such a colossal undertaking as a large-scale topographic map of the United States takes time and money. The project, begun many years ago, has been persistently carried on: the primary triangulation and control are by the U. S. Coast and Geodetic Survey; the detailed mapping is by the Geological Survey.

Feeling that the industry of the country demanded the systematic carrying out of this project, a bill was introduced and passed to this end by the 68th Congress, by a record vote. This act—the Temple bill (H. R. 4522)—authorized a regular appropriation for this purpose, which funding would in twenty years accomplish the completion of the map. The yearly amount provided for—beginning July 1, 1926—was $950,000, of which $750,000 was for the Geological Survey part of the work and $200,000 for that part of the job which belongs to the Coast and Geodetic Survey.

One of the consequences of the President's most laudable campaign of economy, as carried out by the energetic Director of the Budget, has been a move to nullify this bill; for the Budget Director has ignored its provisions, and has in his budget asked for $477,000 for the coming fiscal year, instead of $950,000 as provided. Great as sympathy is for the reduction of government expense, engineers and the public will hardly sympathize with this reduction, believing that it will not save money for the country in the long run; they may, indeed, be reminded of the case of the engineer who sent in to his board of directors specifications for material for bridging a river. The directors, having embarked on a campaign of cutting expenses, reduced his estimate in half; and sent him material which he discovered would go halfway across.

How to Use Lime

IT IS WELL to know how to do some of the simple things about a plant as well as to work out the most efficient method of treating a complex ore, though the simple thing is usually done in the most evident and convenient way, and gets little thought from the research department. Most people, for example, would give scant attention as to how lime was added to a mill circuit, and yet, as Clark T. Henderson pointed out in the last issue, there is a right and a wrong way to do it, and the wrong way is, of course, more costly. This particular method of slacking lime recommended by Mr. Henderson, using a large volume of water, not only improves the chemical qualities of the resulting solution, but also keeps the solid material in suspension for a much longer time than would be the case otherwise.

One of the troubles that the millman has to contend with, in his use of lime for alkalizing a mill circuit, is the deposition of carbonate of lime on the pipes and receptacles that carry and contain the mill solutions and pulps, and any means that may be used to decrease this nuisance will indeed be welcome. Though Mr. Henderson, in his original manuscript, spoke only of the application of the idea to flotation circuits, it would appear that the information would be of value to any one using a process in which lime is used as an alkaline reagent, and of course the cyanide process, in which lime is used to secure protective alkalinity of the solution, immediately comes to mind.

Incidentally, this brief article is evidence of the fact that manufacturers of mining supplies are continually working in the interest of the users, at the same time, of course, benefiting themselves. Much valuable infor-

specialists, not in his line, in that he receives the same benefits as the rest of the public. But is his reward for his specific work as great as it should be?

With the endless number of subjects taught in our universities time will not permit each student to become an expert in all lines; for long before he would have become proficient in all things his allotted span of life would have been reached; and then all would be lost, for he would not be able to utilize his acquired knowledge to any purpose.

A liberal education is nevertheless desirable, and even essential, to accomplish the best results. Dr. Butler says: "A liberal education is one that is fit for a free man who is worthy of his freedom. To this end he must have a grasp on the fundamental facts in the history of man and of nature, and at least the beginning of an understanding of those great historic movements in the fields of intelligence, of morals, of letters, of science, of the fine arts and of the social and political endeavor which make up the warp and woof of that finished fabric which we call civilization."

This definition is all-embracing; however, there is no harm in hitching our wagon to a star. Looking up, forward, out and all around, takes the mind from specialized work for a time.

Is the average mining engineer or other technical man the product of such training? As often pointed out, he does not take kindly to civic affairs, which is a large part of his environment. Specialized training and education prevent him from getting a world view of his surroundings. He often feels ill at ease in the presence of the man of vision and liberal education; an "inferiority complex" comes over him when he is called upon to speak on topics outside of his specialty—topics with which he should have at least a speaking acquaintance. He can converse only on his specialized subject, and in this most people are not particularly interested. It is true that as a rule the engineer is a much-traveled man; but having nothing more than a high-school course in history, art, and literature (most of which is soon forgotten), he does not grasp the opportunity to broaden his education.

The lack of this broader education often prevents making contact with men in high executive positions. To them he is only a chemist or an engineer doing his job so satisfactorily that the management is perfectly willing to let him remain where he is rather than try him out in a higher position and break in a new chemist or engineer.

One would rightly judge, if the above is true, that our scientific and engineering courses should be changed. They are actually being changed, in that phases of commerce are being studied in connection with engineering. We could well add some real history and literature, so the student would at least know something of the outstanding characters in the years gone by—something of the masterpieces of art and literature. The student in a technical school often scoffs at the idea of taking lectures in English and composition. This is because he does not realize the value of a little polish in the engineer's report that he may some day make. A well-written report will receive consideration, where one slovenly prepared may go to the waste basket. Furthermore, it is a matter of economy and efficiency if he can write fluently, for he will prepare his reports in half the time that he would require without a knowledge of the mother tongue.

Excess Capacity and Time Lost

IRON-ORE OPERATORS of the Lake Superior district who are suffering from the present excess of 30,000,000 tons in annual productive capacity may find some consolation, perhaps, in considering the bituminous industry, which also is afflicted with too many mines. Excess capacity, with its attendant evils, tends to weaken the market for the product mined, where numerous competitive companies are concerned. Thus it hits the operator in the pocket.

What it does to the miner is strikingly indicated in figures presented by Secretary of Labor Davis at the Washington convention of the Mining Congress recently. Quoting statistics of the Geological Survey, Mr. Davis said that a billion and a quarter man-days had been lost in twenty years by the bituminous miners, 86 per cent of which was from causes other than strikes—no markets, car shortage, mine disabilities, and the like. That is, an average of sixty million man-days were lost annually by the bituminous workers. This loss of a billion and a quarter man-days in a score of years, from causes other than strikes, made the strike loss look small by comparison, the Secretary said. Translating this into dollars and cents, the reader with a bit of imagination will have no difficulty in understanding why labor disturbances have been so frequent.

The Oil-Electric Locomotive

THE COMBINATION of an electrically operated locomotive with a self-contained Diesel-generator unit mounted upon the locomotive and supplying the electrical energy for its operation has passed through the preliminary stages and a complete unit is being tried out in freight service near New York. The combination has the important advantages of avoiding boiler operation, the need for replenishing water supply, ease in fueling, smokeless operation and a high fuel economy. A 100-ton engine of this type consumed 473 gal. of fuel in traversing a distance of 537 miles, the cost being given as 4.36c. per mile for fuel, according to a published account.

The new locomotive may find application in open-pit mining operations, especially where it is necessary to transport ore over considerable distances and when water is scarce and it is necessary to bring fuel in over considerable distances. The locomotive unit being completely self-contained has none of the disadvantages of trolley-type locomotives and avoids those of the storage-battery type.

Money in Oil

FORTUNATE are the registered members of the Osage Indian tribe of Oklahoma. Each has received the tidy sum of $13,200 during the last fiscal year, as his share of the royalties and bonuses derived in that period from the oil and gas lands on the reservation, the Interior Department announces. This is the largest amount ever paid per capita for this purpose.

The Osage reservation comprises about one and a half million acres of land and produced almost 34,000,000 bbl. of oil in the fiscal year referred to. The registered members number 2,229. However badly some of the Indian tribes have been treated by the white man, certainly the Osage have no cause for complaint.

mation and many good ideas lie hidden away in the minds and files of the engineers connected with the manufacturing branch of the mining industries, and they are performing a service when they contribute to the dissemination of useful knowledge.

Move to Standardize Drafting Practice

THE WAY in which working drawings for structures, buildings, and machines of various kinds are arranged is determined by the draftsman making the drawing or by the practice of the particular office in which he may work. As a byproduct of technical education a fairly uniform procedure is in vogue, and working drawings can in most instances be interpreted without special difficulty. While attempts have been successfully made to standardize conventions, lettering and dimensioning, no complete code of authorized drafting practice has been formulated for general use. A plan to undertake a national program for the standardization and simplification of the practices, materials, and instruments has just been decided upon by the American Engineering Standards Committee. The program includes classification, arrangement of views and sections, methods of indicating dimensions and tolerances, the use of symbols and shortcuts for illustrating details and the minutiae of titles, notes and changes in diagrams. The objective of the committee is in line with modern progress.

Drawings are one of the means of communication between the engineer and his designers and the shop or the construction camp. In a sense they play a similar rôle to that of the written or printed page. And in a similar way it is necessary to have a more or less common practice in vogue with reference to the technic of drawing. No doubt the Standards Committee will speedily crystallize ordinary drafting practices into a definite standardization, which should be published under such auspices that the printed manual will find general circulation. In the work of the committee, drafting practice in mine mapping deserves a separate chapter.

Wanted: Better Patents

PATENT LITIGATION has not attracted a great deal of attention in the mining field since the Minerals Separation flotation suits have quieted down, though copper metallurgists have followed with interest recent legal enactments regarding basic converting and the charging of reverberatory furnaces. It is really surprising that there is not more litigation over patents when the conditions under which they are applied for and issued are considered. The inventor of a new appliance or method adapted for use in the mining industries rarely has the ability to state his case clearly, to the satisfaction of the patent examiner, and so that he may be properly covered. He usually calls on a patent lawyer to write his application for him, and the result is often a mass of legal verbiage which is almost meaningless to one unused to that peculiar variety of the English language affected by lawyers.

In the Patent Office are hundreds of young examiners, fresh from college, paid on an average about $150 a month, who pass on these patent applications. To do a good job, they must have a thorough knowledge of the technique of the branch of the industry in which the patent lies, and be able properly to understand just what is being discussed in the application and to adjudge the claims. From both of these standpoints they often fail; and as a result we have a mass of patents and parts of patents that never should have been issued. No one takes a patent very seriously until after its validity has been upheld by the courts, a validity which should have been assured by its issuance by the Patent Office. Given plenty of money with which to employ clever lawyers, most patents can be evaded with little difficulty.

The remedies suggested in a comprehensive review of the whole situation made by Paul Truesdell for the *National Petroleum News* lie in higher salaries for the patent examiners, in increasing the dignity of their position, and in giving them actual training and knowledge of the industries in which their work lies. These all seem worthy of attention.

In casually browsing through the patents issued each week during the last few years, one cannot but be struck by the number of what must certainly be useless patents, and by the lack of novelty in many of the claims of lots of others. Occasionally, of course, something of interest comes along: for example, Patent No. 1,425,185, issued to Risdale Ellis three years ago, contains a very creditable essay on the theory of flotation in good technical English. On the other hand, it seems that some patents must be taken out as a joke. So that those readers who have had a merry Christmas may extend their merriment into the new year, and as a small contribution to National Laugh Month, below is given a portion of the text of patent No. 1,180,753, issued to William P. Zeigler, and brought to light by the petroleum magazine mentioned above. The patent covers an artificial fish bait in which mirrors are used. Here is the way it is supposed to play upon the emotions of the fish:

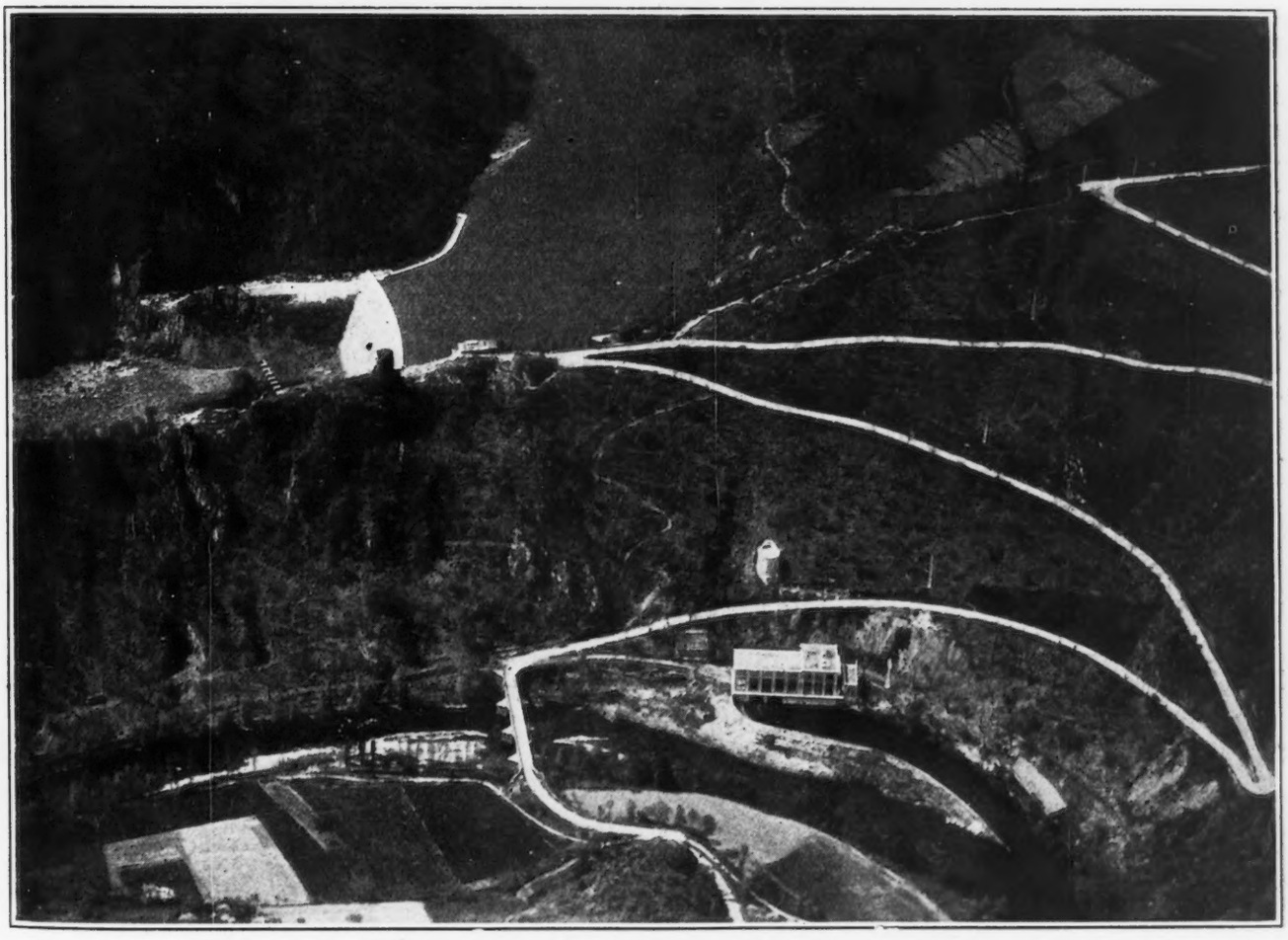
> A male fish seeing his image upon looking therein (in the mirror) will appear to see another fish approach it from the opposite side with the intent to seize the bait, and this will not only arouse his warlike spirit, but also appeal to his greed, and he will seize the bait quickly in order to defeat the approaching rival.
>
> In case the fish is suspected of cowardice I may make the mirror of convex form, in order that the rival or antagonist may appear to be smaller.
>
> In the case of a female fish, the attractiveness of a mirror is too well known to need discussion. Thus the bait appeals to the ruling passion of both sexes, and renders it very certain and efficient in operation.

Specialization in Education

DR. NICHOLAS MURRAY BUTLER in a recent address strongly condemned the present system of education that turns out specialists in lieu of broad-minded, well-informed, and liberally educated men. He says that: "Specialization is the parent of information and of a certain type of skill, but it is the foe of knowledge and the mortal enemy of wisdom."

This is a day and age of specialists; and without specialists progress would not be so rapid. The chemist who discovers an antitoxin for a contagious disease; the metallurgist who shows how to recover an extra pound of copper from the ore; the engineer who designs a city water system; the geologist who points the way to a new fuel supply; each and all confer a benefit upon mankind, which cannot be measured in the coin of the realm. The specialist profits by the work of other

Zinc smelting plant of the Vieille-Montagne company at Viviez, France, which is equipped with over 3,000 retorts



Airplane view showing electric power station that supplies the Vieille-Montagne company's electrolytic zinc plant at Viviez

Vieille-Montagne—a Pioneer in the Zinc Industry

Organized Eighty-eight Years Ago, This Company Now Conducts Operations in Ten Countries, or Colonies, Employing Nearly 13,000 Men

By Gaston Saint-Paul de Sinçay
General Managing Director, Vieille-Montagne Zinc Co.
Chênée, Belgium

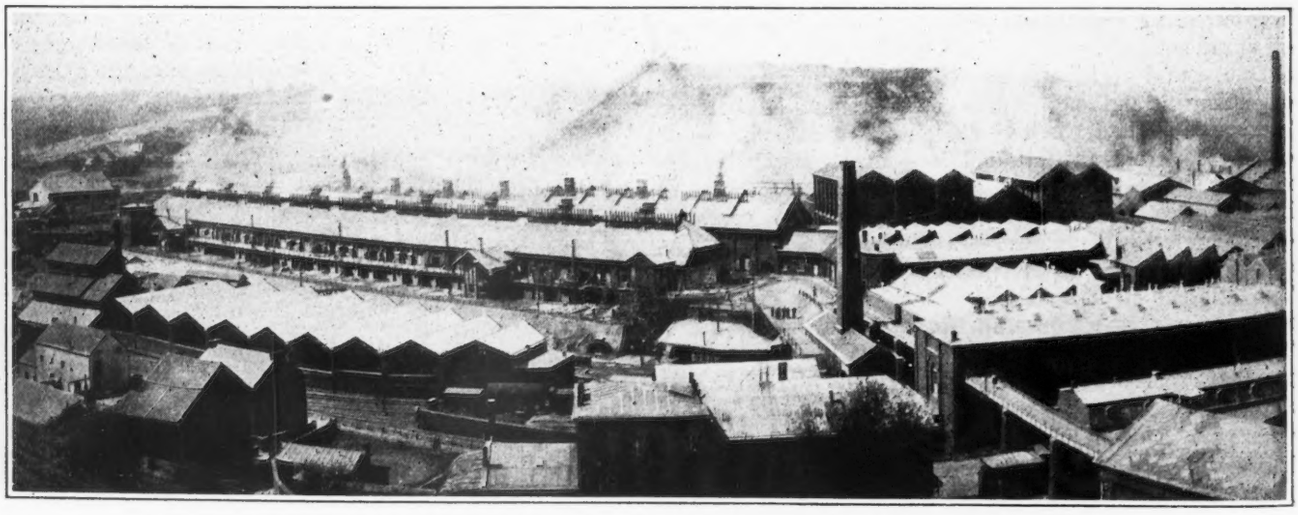
Gaston Saint-Paul de Sinçay

THE VIEILLE-MONTAGNE Zinc Co., the longest established and most important of European zinc concerns, was formed in 1837 by the successors to Dony, the popular inventor who was the first to succeed in obtaining zinc in the perfect metal state by an industrial process. At the time of its formation, eighty-eight years ago, the company possessed only one mine, at Moresnet—an autonomous little republic of an area of about 1½ square miles, between Belgium and Prussia, 4 miles southwest of Aix-la-Chapelle. This mine had been operated since the fifteenth century. Also, the company at that time owned one smelting plant (no longer in existence) at St. Leonard's, Liége, and two small rolling mills. Its production of slab zinc during the first year amounted to only 1,833 metric tons. Since then, the growth of the business has been continuous, and striking evidence of the company's progress is afforded by the fact that, during the last year before the war, the production of slab zinc exceeded 100,000 metric tons, being more than one-tenth of the total world production during that year. Such results could not have been achieved without a corresponding expansion of the interests and sources of supply of the company, whose mining estates or agencies, in ten countries or colonies, now number fifty, affording employment to nearly 12,000 workers, in addition to a clerical and technical staff of approximately 700. The activities of the various branches and agencies are controlled and co-ordinated from the company's central offices at Angleur par Chênée (Liége-Belgium).

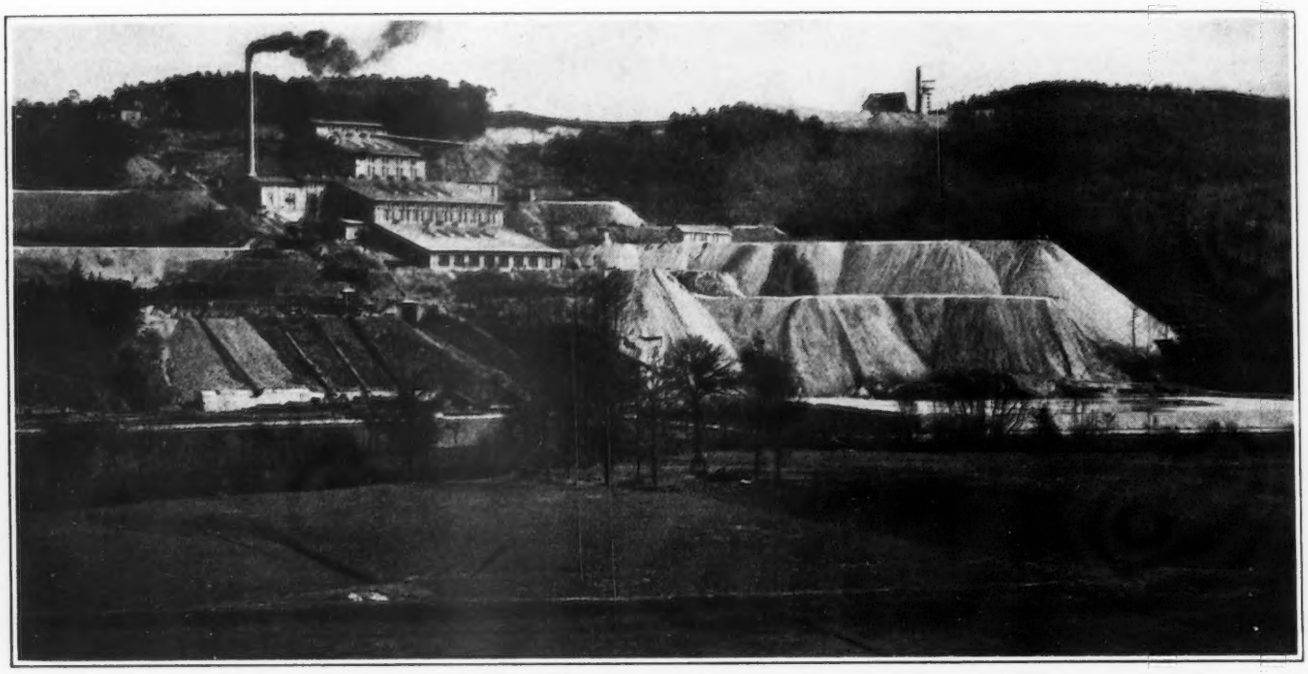
The Vieille-Montagne takes its name from the mine at Moresnet, known as the Altenberg mine, of which "Vieille-Montagne" is the French rendering. This mine, though operated continuously since the fifteenth century, has always yielded considerable quantities of high-grade calamine, blende, and galena and has been of considerable assistance to the company in contributing to meet the requirements, every year more exacting, of its mills. It is estimated that the Vieille-Montagne alone has so far produced about two and a half million tons of ore.

It was at Moresnet, sixty years ago, that mechanical drilling by compressed air was first practiced; and that nitroglycerine, dynamite, and similar explosives were first used. It was likewise at Moresnet that Wolf installed his first double-cylinder pump, and there Kley constructed his first rotary pumps, which gave such remarkably variable discharges.

The mining interests of the company, however, are by no means confined to the Moresnet property. They extend to several countries: notably Sweden, where the Vieille-Montagne, nearly seventy years ago, acquired a magnificent mining estate covering approximately 5,000 acres and producing blende; Germany, where the

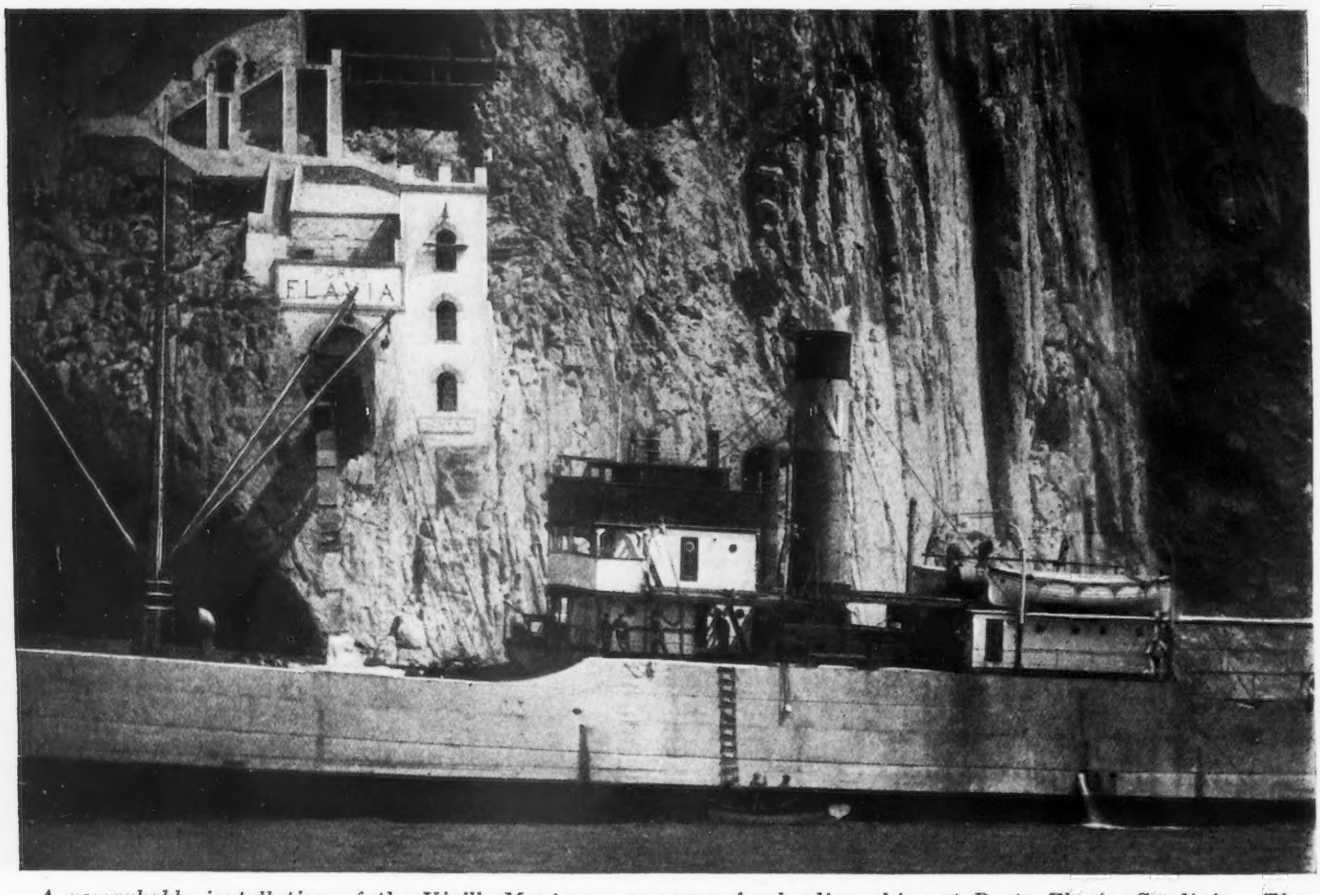


Zinc smelter and oxide plant of the Vieille-Montagne company, at Valentin Cocq, Belgium



The Bensberg zinc mine of the Vieille-Montagne company, comprising over 50,000 acres in the Rhineland, Germany

Bensberg (Rhineland) property covers more than 50,000 acres and supplies blende and galena; Italy (Sardinia and Bergamo), where the company operates several calamine holdings; and North Africa (Algeria and Tunis), whence the company obtains supplies of calamine and galena, in addition to a unique variety of antimony ore, known as Hamman antimoniate of iron. The list of the company's mining estates would not be complete without mention of the Gard mines, in France, and the Nenthead mines, in Cumberland, England, and the com-



A remarkable installation of the Vieille-Montagne company for loading ships at Porto Flavia, Sardinia. The ore is carried by belt conveyors through a tunnel cut in the rock. The loading capacity is 400 long tons per hour

pany also has a controlling interest in several mining concerns in Italy, Spain, Greece, Norway, and Indo-China.

With regard to the company's reduction works, the oldest and most important are those in the Liége and Campine regions, in Belgium, in the Department of Aveyron, France, and in Rhineland (Germany). They comprise smelting plants, producing ordinary and special grades of zinc; rolling mills; technical workshops; zinc oxide plants; a lead refinery equipped for the recovery of silver and the manufacture of sheet and pipe lead; and roasting plants where sulphuric acid, nitric acid, and superphosphates are produced. Recognizing the importance of modern electric processes in zinc manufacture, the company has installed an extensive plant, involving the creation of central electric-power stations, at Viviez, France, where electrolytic zinc of first-class quality is produced by the latest and best methods. The Vieille-Montagne is the first company in Europe to undertake this particular branch of zinc metallurgy. The total capacity of production of the company is at present approximately 125,000 metric tons of zinc per annum.

On the conclusion of the Great War, the Vieille-Montagne set to work energetically to recover lost ground. Despite the magnitude of the task, its efforts were eminently successful, as can readily be seen from the following figures.

Production in Metric Tons

	1913	1919	1920	1924
Zinc, various grades.....	114,064	31,414	59,139	92,236
Zinc sheets	77,377	36,109	53,714	63,358
Zinc oxide	13,722	7,858	20,784	28,167

With regard to slab zinc and zinc sheets, it will be noticed that the production has now attained 80 to 82 per cent respectively of the 1913 tonnage, while the 1913 production of zinc oxide has been more than doubled.

In 1924, the company's mines yielded 125,000 metric tons of calamine and concentrate, and 7,500 metric tons of galena, exclusive of 10,000 metric tons of ore received from subsidiary concerns. In addition to the output of slab zinc, zinc sheets, and zinc oxide, in 1924, there was produced 12,550 metric tons of lead, 28,400 kilos of silver, and 80,433 metric tons of sulphuric acid.

For forty-five years, the company had the benefit of the expert knowledge and guidance of Mr. Louis-Alexandre Saint-Paul de Sinçay, who acted as managing director from 1846 till 1890, when he was succeeded by his son, the present managing director, Mr. Gaston Saint-Paul de Sinçay, who had collaborated with his father during the previous twelve years.

Several of the company's mining agencies are fitted out with warehouses and equipped with special shipping facilities, this being especially the case at Gothembourg (Sweden), and Cagliari, Carloforte, and Porto Flavia, in Sardinia. At Asia Dock, in the port of Antwerp, spacious buildings, comprising offices, laboratory, and sample-grinding plant, amply suffice for taking delivery of ore consignments and dispatching finished products. Moreover, in connection with the important smelting plant at Viviez, in Aveyron, a first-class receiving agency is maintained at Bordeaux. At London, an agent, with offices at 120 Cannon St., keeps in touch with the market and controls sales.

With a view to supplementing its direct sources of supply, representatives of the company recently visited Mexico, Canada, and the United States, concluded arrangements with various concerns in those countries, and contracted for the purchase of more than 140,000 metric tons of zinc ore. An organization for dealing with such business was created, ensuring execution of and settlement for such purchases with as much promptitude as if the company had its headquarters on the spot. At present, the Vieille-Montagne is represented in Mexico by Mr. A. Blum, mining engineer, Avenida Isabel la Catolica, 25, Mexico, D. F., and on the Pacific Coast by Messrs. Du Val, Moore & Co., 212 California St., San Francisco. The financial branch of the business on the American Continent is transacted through the National City Bank of New York and its various branches and correspondents.

Flotation and Bromocyanide to Eliminate Telluride Troubles

By the use of flotation in the mill of the Wright-Hargreaves mine, at Kirkland Lake, Ontario, tellurides present are being removed from the gold ore immediately after it has passed through the tube mills, according to a note in *The Mining Journal*. The telluride is then treated, and returned at that same place in the circuit at which it is being taken out. By this method, the percentage of recovery has been greatly improved. The tailings from this difficult ore have been reduced to about 80c. per ton. The process has been worked out by James Grant, manager, assisted by W. E. Simpson, Canadian director of the Cassel Cyanide Co., of Canada. It is considered probable the new method will be employed generally throughout the Kirkland Lake district, in which case the additional gold saved from the tailings might reach at least $1,000 per day.

The tellurides are treated by bromocyanide, and the question of a suitable supply at a fair price has been raised. Inquiry into the matter, says *The Mining Journal*, has disclosed the information that, prior to the recent war, all the bromine salts used (chiefly in the Western Australian goldfields) came from Germany. However, immediately following the outbreak of hostilities, the Australian mining companies had to look elsewhere for a supply. It was found that in the mineral wells on the Michigan peninsula a suitable supply could be obtained. Production of bromine on the North American continent has been studiously developed, and one result has been that, although the price is still higher than in the early war period, yet it is lower than that which ruled at any time for the German material.

The price to the Australian mines for the mixed sodium bromide and bromate, ready compounded for use at the mines, has generally been about 44c. per pound, but it is computed that the same material can be landed in Northern Ontario at a price at least 5c. per pound below the Australian figure.

Affinity of Metals for Sulphur

The affinity of metals for sulphur has recently been investigated by the microstatic method, according to an article by W. Guertler in *Metall und Erz* (1925, 22, pp. 199-209). This method embraces a microscopical analysis of the structure of molten mattes. The affinity series arranged in descending order is as follows: Mn, Cu, Fe, Ni, Co, Pb, Sb, and Ag.

Discount Formulas in Valuation of Wasting Assets

Pointing Out Inconsistencies in Usual Calculation

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IN THE VALUATION of a wasting asset, among the various formulas developed for discount to "present worth," one especially has been repeatedly recommended to engineers and is used by the Federal Income Tax Unit in computing allowances for mine depletion. In spite of its general acceptance it is not consistent with itself, and valuations based upon it are invariably understated, as a brief analysis will show.

The basis of valuing any asset is an estimate of the proceeds to be expected from the sale of its use or produce, a basis that underlies even those appraisals founded largely on judgment rather than measurement. When a fair estimate of these proceeds can be made, and estimated costs of exploiting the asset fairly deducted, the resulting "net proceeds" must still be translated in terms of value. Whatever the nature of the asset, its net proceeds must yield earnings on that value at a rate that properly reflects the risk of the enterprise; but in the case of a wasting asset they must also make good the depreciation of value itself. In the customary formula this time-honored requirement is met by means of an assumed sinking fund, to which net proceeds P furnish equal annual installments F of such amount that at exhaustion their aggregate (with interest compounded annually at rate s) shall exactly reproduce original value V. The remaining proceeds then represent earnings, and V, as the dependent variable, is so adjusted that the annual earning rate r properly reflects risk.

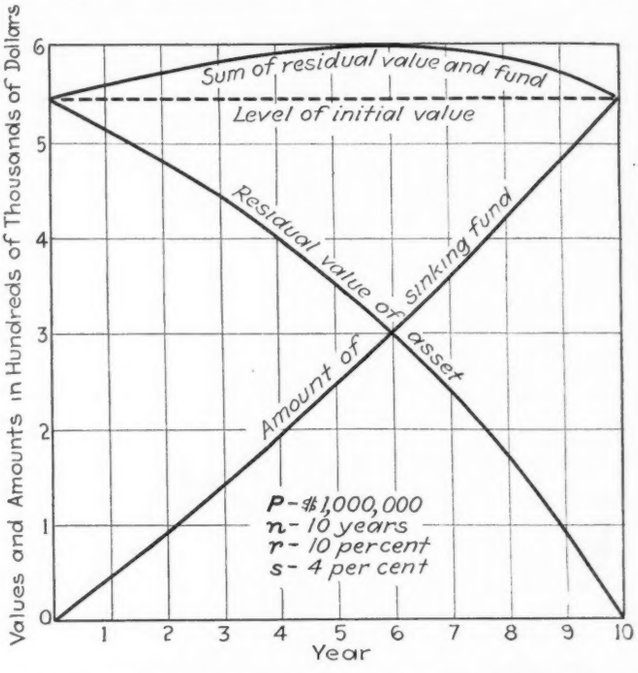
With no specific evidence to the contrary, it is always assumed that net proceeds will be received in equal annual amounts, and this assumption is fundamental to the formula. If the expected life of the asset is n years, its yearly proceeds are $\frac{P}{n}$, and by the premises $\frac{P}{n} = F + rV$. If S is the amount of one dollar for one year at rate s (or $S = 1 + s$), then after one year of exploitation the sinking fund amounts to F, after two years to $FS + F$, after three years to $FS^2 + FS + F$, and after n years to $FS^{n-1} + FS^{n-2} + \ldots\ldots + F$, which may be written $F\,\frac{S^n - 1}{S - 1}$ by substituting for the series its familiar algebraic sum. Similarly, at exhaustion the fund amounts to $F\,\frac{S^n - 1}{S - 1}$ and then equals V, whence $F = \frac{S - 1}{S^n - 1}\,V = \frac{s}{S^n - 1}\,V$. Then $\frac{P}{n} = \frac{s}{S^n - 1}\,V + rV$, from which the usual discount formula may be derived in its familiar form:

$$V = \frac{P(S^n - 1)}{n(s + rS^n - r)} \qquad (1)$$

In all of these analyses r and s are expressed not in percentages but as fractions.

There is nothing in the premises to show how the sinking fund will be invested, whence s cannot be defined by investment risk and must be fixed practically at the bare rate for the use of money: Hoover recommends 4 per cent, and this is the rate adopted by the Federal Government. Since r is invariably a risk rate, it is always greater than s, and this disparity is important in the present analysis.

Although the predictions of valuation are never exactly fulfilled in practice, the consistency of the formula with itself can be tested only by treating its assumptions and estimates as actual facts. On this principle the realization of net proceeds can be traced



year by year from the beginning of exploitation to exhaustion, because they are assumed to be realized in equal annual amounts; then for any intermediate date the proceeds already realized and the proceeds still in reserve can be computed directly from the premises. When a particular date is selected, the residual life of the asset is known as a matter of course, and this, together with the proceeds in reserve, can be inserted in the formula (with r and s unchanged) to determine the residual value of the asset at that date. For the same intermediate date the premises also determine the amount of the sinking fund thus far accumulated, and initial value V is obviously represented at this time by the sum of fund to date and residual value, both of them computed solely from the primary assumptions of the formula. If this sum be less than V, the latter may still be a true value, for it can always be recovered from the sinking fund at exhaustion; but if the sum at any time exceed V, then the formula asserts that after yielding adequate earnings for a part of its total life, the asset and fund together should be liquidated for more than initial value, which therefore must be understated. As a matter of fact, the sum of fund to date and residual value exceeds V at all times between the beginning of exploitation and exhaustion.

This can be demonstrated as follows: A graph like

that on page 8 can present only one specific case, but analysis shows that its implications are general. After a years of exploitation (less than n) the asset's residual life is $n - a$, and the net proceeds still in reserve obviously amount to $\frac{P}{n}(n - a)$. Then by Formula 1 the residual value after a years equals

$$\frac{P}{n}(n-a)\frac{S^{n-a}-1}{(n-a)(s+rS^{n-a}-r)} = \frac{P(S^{n-a}-1)}{n(s+rS^{n-a}-r)} \quad (2)$$

It has been shown that at this time the sinking fund amounts to

$$F\frac{S^a-1}{s} = \frac{Vs}{S^n-1}\frac{S^a-1}{s} = \frac{S^a-1}{S^n-1}V,$$

or placing V by its equivalent in Formula 1, the fund to date equals

$$\frac{S^a-1}{S^n-1}\frac{P(S^n-1)}{n(s+rS^n-r)} = \frac{P(S^a-1)}{n(s+rS^n-r)} \quad (3)$$

Formulas 2 and 3 may now be combined in an equation for the sum (T) of fund to date and residual value:

$$T = \frac{P(S^{n-a}-1)}{n(s+rS^{n-a}-r)} + \frac{P(S^a-1)}{n(s+rS^n-r)} = \frac{P}{n}\left[\frac{S^{n-a}-1}{s+rS^{n-a}-r} + \frac{S^a-1}{s+rS^n-r}\right] \quad (4)$$

The problem is to determine whether T equals, exceeds or is less than V.

For this purpose Formula 4 may be written in equivalent form:

$$T = \frac{P}{n(s+rS^n-r)} \times \left[\frac{(S^{n-a}-1)(s+rS^n-r)}{s+rS^{n-a}-r} + (S^a-1)\right] \quad (5)$$

The expression

$$\frac{(S^{n-a}-1)(s+rS^n-r)}{s+rS^{n-a}-r}$$

may be reduced as follows:

$$\frac{(S^{n-a}-1)(s+rS^n-r)}{s+rS^{n-a}-r}$$

$$= \frac{(S^{n-a}-1)(s+rS^n-r) + sS^n - sS^n + s - s}{s+rS^{n-a}-r}$$

$$= \frac{sS^{n-a} - s + rS^n(S^{n-a}-1) - r(S^{n-a}-1) + sS^n - sS^n + s - s}{s+r(S^{n-a}-r)}$$

$$= \frac{sS^n + S^n(rS^{n-a}-r) - s - (rS^{n-a}-r) - sS^n + sS^{n-a}}{s+rS^{n-a}-r}$$

$$= \frac{S^n(s+rS^{n-a}-r) - (s+rS^{n-a}-r) - (sS^n - sS^{n-a})}{s+rS^{n-a}-r}$$

$$= S^n - 1 - \frac{sS^n - sS^{n-a}}{s+rS^{n-a}-r}$$

Equation 5 then becomes

$$T = \frac{P}{n(s+rS^n-r)}\left[S^n - 1 + S^a - 1 - \frac{sS^n - sS^{n-a}}{s+rS^{n-a}-r}\right]$$

$$= \frac{P(S^n-1)}{n(s+rS^n-r)} + \frac{P}{n(s+rS^n-r)}\left[S^a - 1 - \frac{sS^n - sS^{n-a}}{s+rS^{n-a}-r}\right] =$$

$$V + \frac{P}{n(s+rS^n-r)}\left[S^a - 1 - \frac{sS^n - sS^{n-a}}{s+rS^{n-a}-r}\right] \quad (6)$$

Equation 6 takes the form $T = V + E$, and the relation of T to V depends on whether E is positive, negative or zero. But

$$E = \frac{P}{n(s+rS^n-r)}\left[S^a - 1 - \frac{sS^n - sS^{n-a}}{s+rS^{n-a}-r}\right]$$

$$= \frac{P}{n(s+rS^n-r)}\left[S^a - 1 - \frac{sS^n - sS^{n-a}}{rS^{n-a} - (r-s)}\right]$$

$$= \frac{P}{n(s+rS^n-r)}\left[\frac{rS^n - rS^{n-a} - S^a(r-s) + (r-s) - sS^n + sS^{n-a}}{s+rS^{n-a}-r}\right]$$

$$= \frac{P}{n(s+rS^n-r)}\left[\frac{(r-s)(S^n - S^{n-a} - S^a + 1}{s+rS^{n-a}-r}\right] \quad (7)$$

By definition S is always greater than unity, whence $(rS^n - r)$, $(rS^{n-a} - r)$, $(S^a - 1)$ and $(S^{n-a} - 1)$ must be positive, and the denominator in Equation 7 is therefore positive. Also, $(S^n - S^{n-a} - S^a + 1)$

$$= (S^n - S^{n-a}) - (S^a - 1)$$
$$= S^{n-a}(S^a - 1) - (S^a - 1)$$
$$= (S^{n-a} - 1)(S^a - 1);$$

and since $S^{n-a} - 1$ and $S^a - 1$ are both positive, $S^n - S^{n-a} - S^a + 1$ is positive. Then, if r exceeds s, E is a positive quantity and T exceeds V for all values of a between $a = 0$ and $a = n$.

There are few investors who would accept the usual sinking-fund rate as a fair measure of industrial or mining risk, whence as Formula 1 is commonly applied r always exceeds s, and the formula definitely asserts that at all times between the beginning of exploitation and exhaustion a complete liquidation should realize more than the initial value. Furthermore, since the residual asset is appraised for liquidation at a value determined by the same formula and fully recoverable at exhaustion, there can be no loss subsequent to liquidation tending to offset the excess.

The next problem is to show that this excess may be large enough to have some practical bearing on valuation. If a_o is that value of a for which T is maximum, a_o is found from Equation 4 by equating to zero the first derivative of T with respect to a, and solving for the latter; then

$$a_o = n - \frac{\log\left[\dfrac{r-s}{r - \sqrt{\dfrac{s(s+rS^n-r)}{S^n}}}\right]}{\log S}$$

and it may be shown that for this value of a the sinking fund to date and residual value are equal; that is, T becomes a maximum where in the graph the curves of fund and residual value intersect. To find the maximum value of E (or maximum excess of T over V), a_o is substituted for a in Equation 7; and the ratio of this maximum excess to initial value is

$$\frac{\sqrt{s+rS^n-r} - \sqrt{sS^n}}{\sqrt{s+rS^n-r} + \sqrt{sS^n}}$$

For a 10 per cent risk rate, 4 per cent sinking-fund rate and ten-year life, by this expression the excess reaches a maximum of about 10 per cent of initial value, a discrepancy large enough to be of very definite practical importance, especially in the depletion allowances of mine taxation.

Formula 1 can be forced to yield constant results for T in one of two ways: either by making r and s equal (Equation 7), or by treating r as a variable in computing residual values from year to year. To test the first method, Formula 1 may then be written

$V = \dfrac{P/n}{\dfrac{s}{S^n - 1} + r}$; then any decrease in r increases V, and any increase in s also increases V, for

$$\frac{s}{S^n - 1} = \frac{s}{(1+s)^n - 1} = \frac{s}{ns + \dfrac{n(n-1)}{2}s^2 + \text{etc.}} = \frac{1}{n + \dfrac{n(n-1)}{2}s + \text{etc.}}$$

whence an increase in s decreases $\dfrac{s}{S^n - 1}$. In other words, within the range between customary sinking-fund rates and the established risk rate of the enterprise, r and s cannot approach each other without forcing a higher initial value and implying undervaluation by Formula 1 as it is usually employed. As a cure, the second method is worse than the disease: because, in order to maintain T constant by varying r, it is necessary to use higher and higher values of r as the asset approaches exhaustion, whereas the risk —if it vary at all—should rationally decrease as exploitation progresses, and r should gradually diminish. In the example shown in the graph, T can be held to a constant value V one year prior to exhaustion only by using the absurd risk rate of 54 per cent per year.

Cause of the Inconsistency

At first sight, the inconsistency that has just been proven in Formula 1 might be ascribed to complications introduced by the sinking fund, especially as the degree of inconsistency is known to depend (Equation 7) on the disparity between r and s. As a matter of fact, the reason for the discrepancy lies far deeper, and the sinking-fund device actually serves as a partial corrective. To develop a consistent formula it is necessary to revert to first principles, correct the trouble at its source, and build anew: but it will be found that the resulting formula, developed in opposition to the sinking-fund idea, is confirmed by Formula 1 when $r = s$.

The exploitation of a wasting asset implies depreciation of its initial value, and its exhaustion involves total depreciation equal in amount to that value. The sinking fund is a device for setting up the proper "depreciation reserve," but a simpler (if less desirable) method is to make good the depreciation out of net proceeds as it occurs. On this principle, if W is initial value (on which interest is paid yearly at rate r), and if net proceeds are realized as before in equal annual amounts $\dfrac{P}{n}$, then depreciation is made good in equal annual amounts $\dfrac{P}{n} - rW$, which must be equal to $\dfrac{W}{n}$ each to offset total depreciation W in n years. Then $\dfrac{P}{n} = rW + \dfrac{W}{n}$ and

$$W = \frac{P}{1+rn} \tag{8}$$

After a years of exploitation the net proceeds still in reserve are $\dfrac{n-a}{n}P$ and residual life is $(n-a)$ years, whence by Formula 8 the asset has a residual value

$$X = \frac{\dfrac{n-a}{n}P}{1+r(n-a)} \tag{9}$$

The depreciation made good to date is $a\dfrac{W}{n} = \dfrac{aP/n}{1+rn}$, and the sum of these two quantities is

$$\frac{\dfrac{n-a}{n}P}{1+r(n-a)} + \frac{aP/n}{1+rn} = \frac{\dfrac{n-a}{n}P}{1+r(n-a)} + \left[\frac{P}{1+rn} - \frac{\dfrac{n-a}{n}P}{1+rn}\right] = \frac{P}{1+rn} + \frac{\dfrac{n-a}{n}P}{1+r(n-a)} - \frac{\dfrac{n-a}{n}P}{1+rn} = W + \frac{n-a}{n}P\left[\frac{1}{1+r(n-a)} - \frac{1}{1+rn}\right] \tag{10}$$

Equation 10 takes the form $X + \dfrac{a}{n}W = W + G$, and it is evident by inspection that G is positive. A moment's reflection will show that G and E (Equation 7) are quantities of the same kind, for each represents an excess—over initial value—of residual value plus the fund (or aggregate payment) to date designed to make good the depletion of the asset.

Equation 9 may be written

$X + r(n-a)X = \dfrac{n-a}{n}P$, whence $\dfrac{X}{n-a} + rX = \dfrac{P}{n}$

It has been shown that $\dfrac{W}{n} + rW = \dfrac{P}{n}$, whence $\dfrac{W}{n} + rW = \dfrac{X}{n-a} + rX$.

Then $r(W - X) = \dfrac{X}{n-a} - \dfrac{W}{n}$ and

$$r(n-a)(W-X) = X - \frac{n-a}{n}W = X + \frac{a}{n}W - W = G \text{ (Equation 10)}.$$

In other words, the excess G, which measures the inconsistency of Formula 8, is equal to interest at rate r on $W - X$ for the residual life of the asset; and $W - X$ is evidently depletion to date. The Formula 8 is inconsistent to the extent that it requires the asset to yield interest on depletion as well as on residual value: for the formula provides interest for life on a fixed principal W, in spite of the fact that it is progressively liquidating that principal at the rate of $\dfrac{W}{n}$ per year.

The next step is to show that the inconsistency of Formula 1 is traceable to the same cause. For this purpose the formula may be written $n(s + rS^n - r)V = P(S^n - 1)$, whence

$$nsV + nrV(S^n - 1) = P(S^n - 1)$$

and

$$\frac{nsV}{S^n - 1} + nrV = P.$$

Transposed, this last equation becomes

$$nrV = P - \frac{nsV}{S^n - 1}$$

With V added to both members it becomes

$$V + nrV = P + V - \frac{nsV}{S^n - 1} \tag{11}$$

Since $\dfrac{sV}{S^n - 1}$ is known to equal F, the expression

$V - \frac{nsV}{S^n - 1}$ may be written $V - nF$, which is the expression for total interest on the sinking fund, because it represents the amount of the fund at exhaustion less the sum of the installments it has received. If this total fund interest be J, then Equation 11 becomes $V + nrV = P + J$ and $V = \frac{P + J}{1 + rn}$ (12)

In other words, V may be derived from Formula 8 no less than W, provided the net proceeds P be augmented by the sinking-fund interest, which comes from an external source and is therefore a real addition to the resources of the enterprise.

By a rather cumbersome algebraic analysis it may be shown that $E = r(n - a)(V - Y) + I + K - J$, wherein Y is residual value by Formula 1 after a years of exploitation (Equation 2); I is interest on the sinking fund to date; and K is total interest on a new fund to replace Y in $(n - a)$ years. Thus E and G express exactly the same kind of inconsistency, the only difference lying in certain adjustments due to sinking-fund interest; and it may be shown that G represents a greater relative inconsistency than E. It follows that the contradictions of Formula 1 are due to the same cause as those of Formula 8—namely, its premise of interest for life at r on a fixed principal V, although it expressly provides for progressive liquidation of this principal and its reinvestment in a sinking fund as exploitation proceeds.

The foundation of Formula 1 is this theory of fixed principal in connection with a wasting asset. Since the asset is necessarily depleted by use, the theory is applied, not to the asset itself, but to the investment of which it is the real or potential basis; the assumption is made that capital once invested in the asset remains impounded until exhaustion, when it is released *en bloc*, very much as a bond is redeemed in full at maturity. For example, invested capital is locked partly in the depleting asset, partly in a sinking fund, and gradually passes from one to the other; and the fund must remain intact until exhaustion, else the compounding of interest is halted and the fund falls short of its purpose. As a matter of fact, the theory not only gives rise to the inconsistency of the formula, but may also be disproved on other grounds.

Suppose that after some years of exploitation the residual asset is revalued by Formula 1 and sold at the value thus found. Obviously, the investment required of the purchaser Y will be less than the investment V, real or potential, assigned by the same formula to the original owner. Were the asset to be sold in similar fashion every year, it would represent a descending series of investments, terminating in zero at exhaustion; and if the risk rate remain constant, its yearly interest payments would form a second series parallel to the first. Whether based on the theory of fixed investment or not, any formula will yield similar results, because each appraisal must consider the asset as it stands at date of valuation, regardless of past history, and it is clear that successive valuations of a depleting asset will always produce a descending series of values. Then such an asset can be presumed to represent fixed investment only in the special case of unchanging ownership, a qualification that destroys the theory itself, for the character of an investment does not depend on the identity of the investor.

Clearly, then, a wasting asset represents diminishing investment. a conclusion so obvious from the definition of the asset that the proof would seem rather ponderous were it not for the general acceptance of Formula 1 and its underlying theory. It remains to develop a discount formula from the idea of diminishing investment, and to show that it is consistent.

Formula of Diminishing Investment

Throughout a life of n years, it is assumed that net proceeds will be realized in equal annual amounts of $\frac{P}{n}$ each. This assumption is a thorn in the side of the mining engineer, for no mine ever justified it except by a miracle; but it usually involves less error than the attempt to predict fluctuations in yearly proceeds through a long period of years. The first year's proceeds $\frac{P}{n}$ consist of (1) interest for one year at rate r on initial value V, and (2) liquidation of investment by a sum A, which is obviously equal to

$$\left(\frac{P}{n} - rV\right) \qquad (13)$$

At the end of the first year the residual value of the asset is $V - A$, whence interest paid during the second year is $r(V - A)$, and the liquidation of investment in the second year's proceeds is $\left(\frac{P}{n} - r(V - A)\right)$

$$= \frac{P}{n} - rV + rA = A + rA = A(1 + r) = AR,$$

wherein R is the amount of one dollar for one year at rate r, or $R = 1 + r$.

At the end of the second year the asset has a residual value of $V - A - AR$, whence interest paid during the third year is $r(V - A - AR)$, and the liquidation of investment in the third year's proceeds is

$$\frac{P}{n} - r(V - A - AR)$$

$$= \frac{P}{n} - rV + rA + rAR$$

$$= A + rA + rAR = AR + rAR = AR(1 + r) = AR^2.$$

Similarly, it may be shown that the liquidation of investment in the fourth year's proceeds is AR^3, and in the nth year's proceeds AR^{n-1}.

The sum of these liquidations, carried to exhaustion, must equal initial value V, whence

$$V = A + AR + AR^2 + \ldots\ldots\ldots\ldots + AR^{n-1},$$

or if the series be replaced by its algebraic sum,

$$V = A\frac{R^n - 1}{R - 1} = A\frac{R^n - 1}{r}$$

whence by Equation 13 $V = \left(\frac{P}{n} - rV\right)\frac{R^n - 1}{r}$ and

$$\frac{P}{n} = rV + \frac{rV}{R^n - 1} = rV\left(1 + \frac{1}{R^n - 1}\right)$$

$$= \frac{rVR^n}{R^n - 1};\ \text{then}\ V = \frac{P(R^n - 1)}{nrR^n} \qquad (14)$$

This formula is not new, and its underlying idea of diminishing investment in a wasting asset is familiar enough; it is developed here as the logical outcome of the foregoing analysis, and its consistency is easily proved.

Equation 7 shows that Formula 1 is consistent when $s = r$; and if this requirement be met, Formula 1 becomes

$$V = \frac{P(R^n - 1)}{n(r + rR^n - r)} = \frac{P(R^n - 1)}{nrR^n},$$

in which form it is identical with Formula 14. In

further proof, a residual asset may be valued by the latter formula and the result compared with that part of its original value still awaiting liquidation. After a years of exploitation the residual life of the asset is $(n - a)$ years, and its proceeds in reserve are $\frac{n-a}{n} P$ as before: then by Formula 14 its residual value at that time is

$$\frac{\frac{n-a}{n} P(R^{n-a} - 1)}{(n-a) r R^{n-a}} = \frac{P(R^{n-a} - 1)}{nrR^{n-a}} \qquad (15)$$

The sum of liquidations for a years is

$$A + AR + AR^2 + ... + AR^{a-1} = A\frac{R^a - 1}{r} .$$

$$= \left(\frac{P}{n} - rV\right)\frac{R^a - 1}{r}$$

$$= \left[\frac{P}{n} - \frac{P(R^n - 1)}{nR^n}\right]\frac{R^a - 1}{r}$$

$$= \frac{P}{nr}(R^a - 1)\left[1 - \frac{R^n - 1}{R^n}\right]$$

$$= \frac{P(R^a - 1)}{nrR^n}$$

and from this standpoint residual value (or value still awaiting liquidation) is equal to

$$V - \frac{P(R^a - 1)}{nrR^a}$$

$$= \frac{P(R^n - 1)}{nrR^n} - \frac{P(R^a - 1)}{nrR^n}$$

$$= \frac{P}{nrR^n}[R^n - 1 - R^a + 1]$$

$$= \frac{P(R^n - R^a)}{nrR^n}$$

$$= \frac{P(R^{n-a} - 1)}{nrR^{n-a}},$$

which is identical with its value in Equation 15. Thus Formula 14 yields consistent values throughout the life of the asset.

If this analysis seems rather academic, in view of the errors that always creep into estimates of net proceeds before the discount formula is applied, the answer is that those errors are large enough, without adding a known error of discount. Furthermore, Formula 1 is used in computing depletion allowances in mine taxation: here the estimates of proceeds are fixed, and as far as the taxpayer is concerned have all the force of facts, but the method of discount is still a fair matter for question. It may easily be shown that Formula 14 yields higher values than Formula 1, a result that confirms the charge of undervaluation brought against Formula 1 on other grounds; and if Formula 14 can be successfully defended as the correct method of discount, it deserves to take its place in practice, public and private.

Lead and Zinc in Sardinia

Practically all the lead ore produced in Italy (37,000 metric tons in 1923) is mined in Sardinia, which also produces 60 per cent of the nation's output of zinc ore, which has increased from 84,000 metric tons in 1923 to over 100,000 metric tons in 1924 (*G. Chim. Ind. et Appl.*, July 1925, abstracted in *Chemistry and Industry*). Hitherto these ores have been largely treated abroad, but in consequence of recent developments of hyrdo-electric power in Sardinia an electrolytic zinc plant has been installed by the Società Elettromineraria, which produced over 2,000 tons of metallic zinc in 1924.

World Trade in Phosphate Increasing

The world production of phosphate rock, which in 1913 approximated 7,000,000 tons, declined to a low ebb during the World War period, says *Commerce Reports* of Dec. 21, 1925. The total for 1918 was recorded as 4,262,763 tons. The gradual improvement during recent years in economic conditions in the principal producing and consuming countries has brought about an increased world production. The 1923 output reached the 1913 figure and the 1924 was increased to over 8,000,000 tons, the largest amount yet recorded. Nevertheless, the United States' output fell off 138,917 tons. This country, however, is still the most important producer, being credited with 36 per cent of the total in 1924. Tunis is a close second, with 35 per cent.

The inability of the American phosphate miners to regain their pre-war position during 1924 is due principally to the loss of export trade brought about by the strenuous efforts on the part of North African producers to capture the European markets. The accompanying table indicates that exports from the United States during 1923 and 1924 were approximately 450,000 tons less per year than in 1913:

United States Production and Export of Phosphate Rock

Years	Quantity Mined Long Tons	Exports — Quantity Long Tons	Exports — Value
1913	3,111,221	1,272,892	$9,524,089
1920	4,103,982	1,069,712	10,570,175
1921	2,064,025	733,312	7,320,137
1922	2,417,883	719,294	5,858,167
1923	3,006,706	827,551	5,772,171
1924	2,867,789	818,773	5,120,832

The combined 1924 production of the North African phosphate countries, which include Tunis, Algeria, Morocco, and Egypt, exceeded that of the United States by over 1,000,000 tons. These countries have virtually no home market, and it is to be expected that no efforts will be spared on their part to develop foreign trade. On the average the North African phosphates are lower in grade than high-grade Florida rock, but the close proximity to important consuming markets and low ocean freight rates have now made them formidable competitors in Europe.

Germany continues to hold the first place as an export market for American phosphate, although the trade has changed considerably since 1913. Shipments of high-grade hard rock have declined from 259,441 tons in 1913 to 92,021 in 1924. Exports of land pebble during the same period, however, show an increase of about 25 per cent, the total in 1924 being 129,213 tons. Consumption of phosphate by German agriculturists at the present time is considerably less than in previous years. There has also been a decided shift from phosphate rock to basic phosphate slag, of which Germany imported in 1924, 517,610 tons from the Lorraine, French, Luxemburg, and Saar steel mills.

American phosphates have been supplanted in France by the North African product, but the trade with Spain has increased from 66,998 tons in 1913 to 110,146 in 1924.

Shipments to Japan during the same period have declined from 67,392 tons to 45,733, caused by the exploitation on a large scale of the phosphate deposits of Anguar, which island was mandated to Japan by the treaty of Versailles.

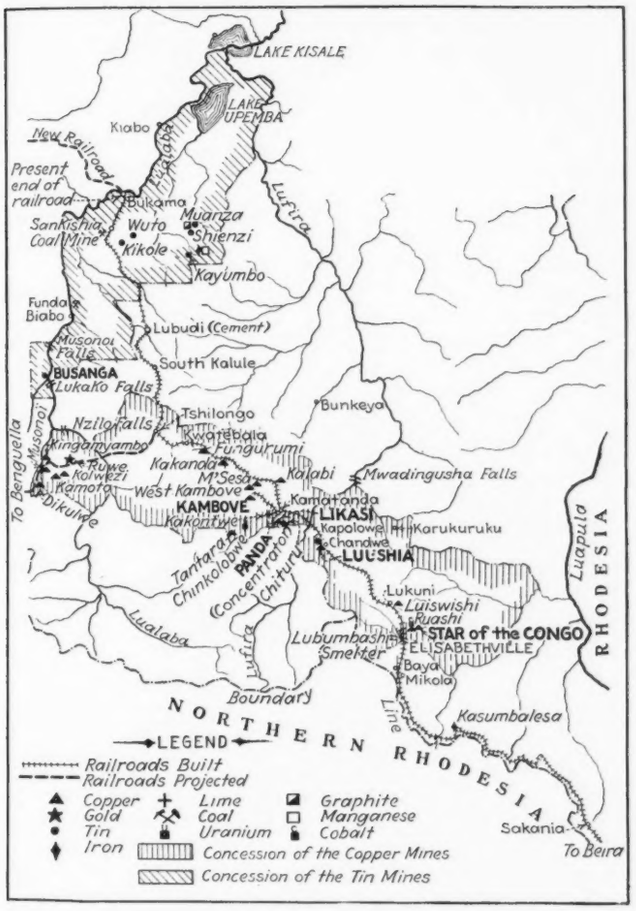
Notwithstanding the large production of phosphate rock by the United States, there has always been a small American import trade in this commodity.

A Journey to South Africa—VI

The Katanga Copper Region—Operations of the Union Minière—Smelter at Lubumbashi—Concentrator at Panda—The Outlook

By T. A. Rickard

BEFORE LEAVING BWANA M'KUBWA we had to be inoculated against smallpox, in order to avoid compulsory vaccination, under unfavorable conditions, at the Belgian border, only 25 miles distant.

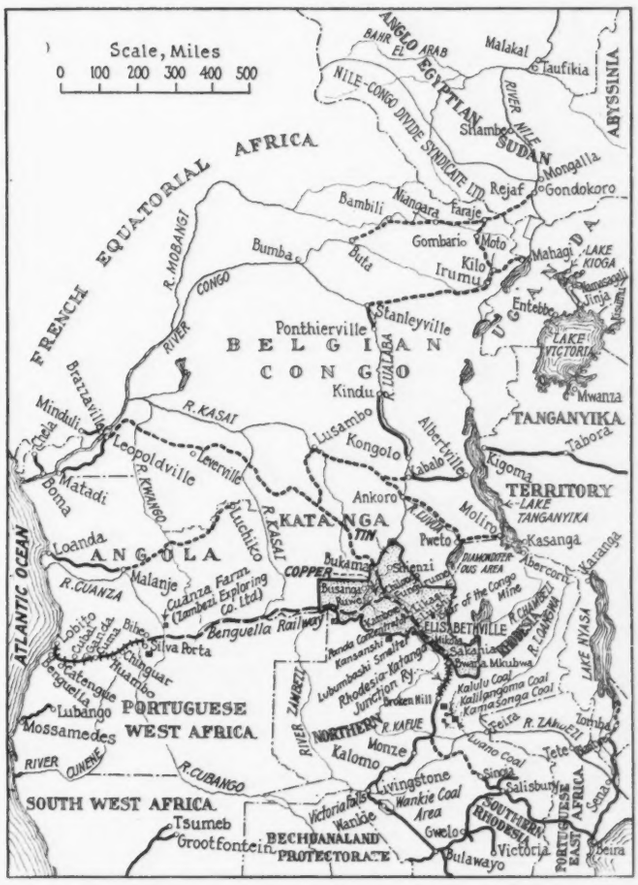


Mining concessions of Union Minière du Haut-Katanga, Belgian Congo, as mapped in 1923

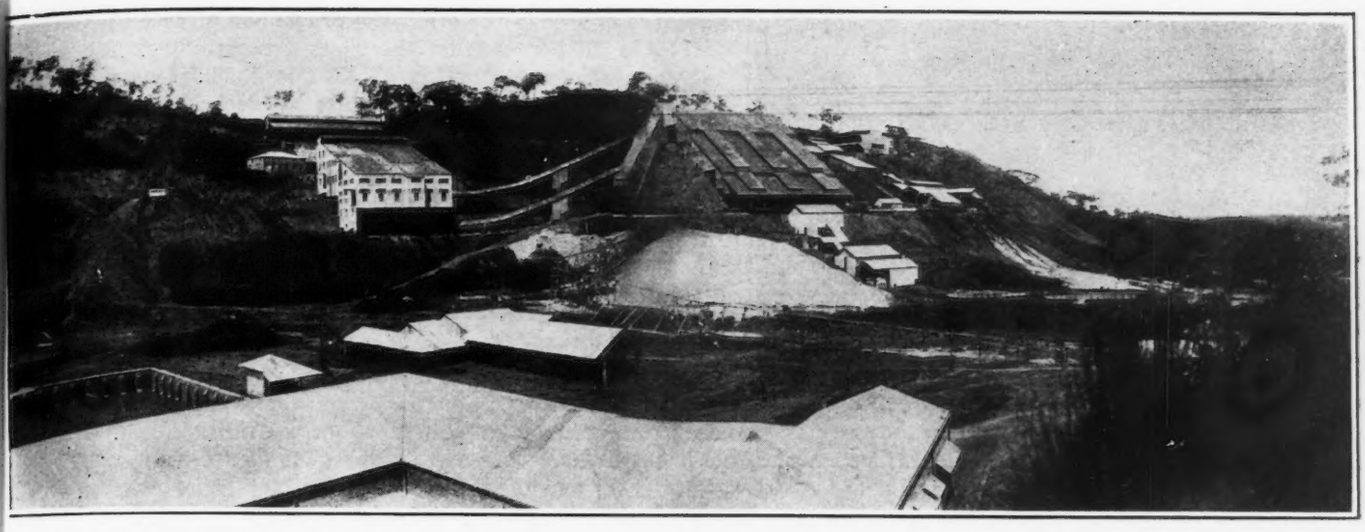
We left our friends, the Dickinsons, on the evening of April 25 and reached the border of the Belgian Congo, at Sakania, during the night. Then, of course, our passports were examined and our medical certificates scrutinized. There was much confusion in the station, and ill-smelling natives jostled us in a way that would not be permitted in Rhodesia, for example. In approaching Elisabethville, next morning, we passed a palm-oil soap-factory, a Catholic native school, a police camp with a fine garden, and a large native compound, all of these suggesting characteristic phases of life and industry in the Katanga province, of which Elisabethville is the capital. The distance from Cape Town is 2,305 miles. At the station we were met, most courteously, by the representative of the Board of the Union Minière, Jules Cousin, together with the smelter manager, Eugene Roger, the manager of the railroad, Charles Janssen, and A. A. Thomson, representing the Tanganyika Concessions, Ltd. Mr. Thomson is the nephew of Robert Williams, the pioneer of the great enterprise that we were about to study; he is also a graduate of the Royal School of Mines, London, so we met under favorable conditions.

Signs Favorable to Copper Deposits

Our quarters were with Mr. Thomson at the Tanganyika house, a charming bungalow set aside for the purpose of entertaining the guests of the Tanganyika company. After luncheon with Mr. and Mrs. Cousin we had our first glimpse of the copper deposits at Luiswishi and Lukuni, in the vicinity of Elisabethville. In both cases the ore was found in a *dambo*, a glade or grassy tract in the forest. Apparently the copper solutions, formed by the action of ground-water on the ore, are prejudicial to the growth of trees, and so leave an open space. Apropos of this observation, I may mention the fact that the green vegetal scum that accumulates in the reservoirs of cities is destroyed by the addition of a minute trace of copper.



Central Africa, showing the concessions of Union Minière du Haut-Katanga, as mapped in 1924. The stippled area near the center is the concession



Crushing plant, concentrator, and flotation and experimental leaching plants

Works of Union Minière du Haut-Katanga Are Situated

million square miles, under the name of the Congo Free State. At that time a pre-emptory right to acquire this state as a colony was granted to Belgium, and this right was duly exercised in 1908, when the name of the country was changed to the Belgian Congo. Another consequence of the Berlin conference was that France was allotted 257,000 square miles in West Africa, now the French Congo, and England was confirmed in her protectorate over the Lower Niger. Thus a large part of Central Africa was partitioned peacefully among the principal claimants.

Cecil Rhodes and Robert Williams

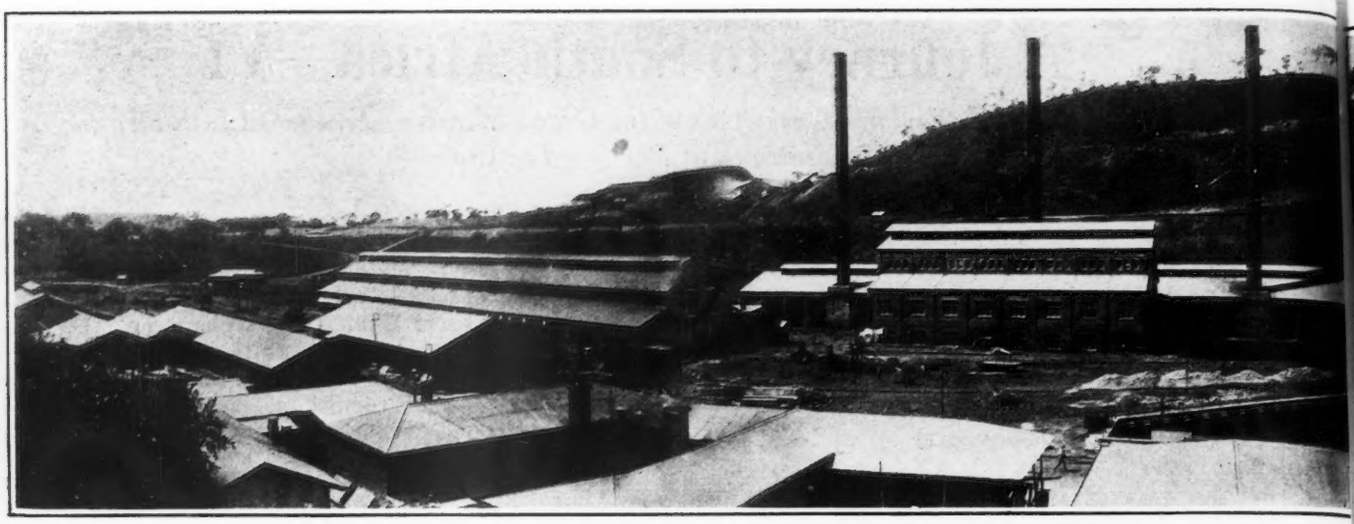
These events interfered with the empire-building plans of Rhodes, who saw the danger of an expansion of Belgian, German, and Portuguese dominion across Africa in such a way as to block his intended extension of British rule from the Cape into the vast hinterlands at the sources of the Nile. He proceeded therefore to organize the British South Africa Company, under a charter granted by the British Government in 1890. Its sphere of action was defined east and south, leaving the north and northwest open to exploration and exploitation. In furtherance of his plans Rhodes asked Robert Williams, a mining engineer and promoter of high character and indomitable initiative, to assist him in making a move into the Katanga, the part of the Belgian Congo nearest to Rhodesia. Reports of the mineral wealth of this region had been brought by various explorers, and Rhodes had obtained information directly from Arnot, a missionary in the Katanga itself.

The Belgians were slow at first to occupy the headwaters of the Congo, despite the urging of Lieutenant Emile Francqui, who knew the country and its resources, and, I believe, was instrumental in having the boundary fixed along the line that separates the watershed of the Congo from that of the Zambesi. Mr. Francqui, together with Jean Jadot, governor of the Société Générale de Belgique, is today the leader of Belgian financial enterprise in the Congo. Rhodes at that critical period sent Alfred Sharpe to make a treaty with the paramount chief; but the time had passed for such action, the country being already within the sphere of Belgian administration. Thereupon a company was formed in Brussels in 1890 with a capital of 3,000,000 francs, a large part of which was subscribed by Englishmen, who were represented by Cameron. This Katanga company, as it was named, acquired a 99-year concession of the mineral rights over a third of the Katanga province.

Deposits Re-discovered in 1891

Several expeditions were sent from Brussels to explore the country, and these confirmed the Belgian occupation. Nothing, however, was done to develop the mineral resources, partly because the inhumane treatment of the natives in the rubber belt of the Lower Congo had provoked an international scandal highly prejudicial to King Leopold's schemes. This, more than anything else, led eventually, in 1908, to the transfer of the country from the King's administration to that of Belgium itself. So the mineral deposits of the Katanga remained neglected until 1891, when they were re-discovered by George Grey, who had been sent thither by Mr. Williams. He himself, three years earlier, had obtained sundry mineral rights from Rhodes, and had organized the Tanganyika Concessions Company to exercise such rights. The name Tanganyika was given to the company simply because, among other things, the rights granted by Rhodes, in behalf of the British South Africa Company, included a mineral concession and a township at the southern end of that lake. In 1906 the interests of the two pioneer enterprises, the Belgian Katanga Company, now represented by the Katanga Special Committee, and the Rhodes-Williams interests, as represented by the Tanganyika Concessions, were acquired by an Anglo-Belgian corporation known as the Union Minière du Haut-Katanga, the consideration being 90,000 shares to the one and 60,000 to the other.

The Union Minière now has a capitalization of 264,000 capital shares of 100 francs and 264,000 dividend shares of no par value. The shares were quoted at 4,900 francs when we were at the mines, and they are now standing at 6,790. In 1923 the dividend was 80 francs per share; in 1925 a dividend of 150 francs was declared for 1924. Besides the ordinary shares there are 300,000 privileged shares, of which 100,000 had been issued formerly and 100,000 this year. After 1928 these shares are entitled to 25 per cent of the profit. They were quoted at 2,400 francs in May.



Machine shop *Power plant*

Panoramic View of Panda, Where the Ore-Dressing

In the Belgian Congo it is said that when searching for copper one has only to select the open spaces. Another fact that was brought to our attention on this the first day of our visit was the existence of "ancient" workings, on the site of the mines now being exploited by our Belgian friends. These workings, in the form of pits and burrows, now covered with turf, are said to have been found wherever new mines have been started. No evidence is forthcoming, however, that these diggings are "ancient"; they are only "old," in the sense that they were made by the natives before the first European prospector arrived, and possibly as much as a century earlier.

The working of the copper deposits was started probably by Arab slave traders from Zanzibar; they compelled the natives to dig, and showed them how to smelt the selected oxidized ore. Thus the indigenous people learned how to get copper out of the rock, and some of them continued their operations after the slave traders had been driven out of the country by the British and the Belgians.

Since writing the above I have found a most significant, and confirmatory, statement in Livingstone's "Last Journals," page 373: "Hassani, with ten slaves, dug at the malachite mines of Katanga for three weeks, and gained a hundred frasilahs of copper, or three thousand five hundred pounds." Hassani was an Arab trader from Zanzibar. Livingstone was writing in 1871, and was referring to Hassani's activities during the previous year—that is, fifty-five years ago. In Livingstone's notes I have found several other references to the copper of Katanga and the exploitation of the deposits by the natives.

It is said that in the localities where copper is found there grows a bush, about the height of a man, named the *mato oba;* it has leaves of brownish green like the phosphate of copper. Another sign of the metal, and one recognized by experienced prospectors in this region, is a small flower of a blue color simulating that of azurite. Moreover, where rich ore exists, the observant seeker for mineral will detect a little bird, with sable plumage, like the color of the black oxide, melaconite; this bird, I am informed, sounds a plaintive note—*mahli, mahli*—just like that—and *mahli* in Swahili means wealth. When all these signs, the open glade, the *mato oba,* the copper flower, and the indicative bird, are present, then the prospector is fully warranted in digging a trench or drilling a hole. Joking apart, I venture to suggest that as the oxidized copper ore occurs where trees do not grow, then it would seem logical to look for sulphide ore where they do grow, because in such places, in the absence of oxidation, there may be none of the acid solutions that are prejudicial to the growth of the larger vegetation.

Leopold II of Belgium Financed Expeditions

Before proceeding further, it will be necessary to recall the events that led to the establishment of the Belgian Congo. This vast region was made known by Lovett Cameron's journey across Africa in 1872. Shortly afterward Henry M. Stanley, who had just returned from his expedition in search of Livingstone, started his exploration of the Congo country, with the financial support of Leopold II, the King of the Belgians. During his travels Stanley made treaties with the native chiefs whereby he obtained rights over large areas. To assume these rights and to administer these territories the International African Association was organized by the Belgian King. In 1876 he called a conference at Brussels for the purpose of making arrangements for governing Central Africa, his idea being to establish a dominion that would be protected from foreign incursion by some sort of international agreement. In 1883 the International African Association was placed on a firm footing with the acquiescence of the governments interested. In the following year a conference of Western European powers was convened by Bismarck at Berlin to consider, among other questions, the protection of commerce on the Congo and Niger rivers, and the formulating of regulations for the further extension of European control in Central Africa.

The immediate result was an enactment declaring freedom of commerce in the basin of the Congo and the delimitation of a maritime belt of 360 miles along the Atlantic coast near the mouth of that river. The navigation of the Congo was to remain open to the ships of all nations even in time of war, and even under an enemy's flag. In 1885 the King of the Belgians formally assumed sovereignty over the territory of the International African Association, a region covering a

the officials, came near it, a sudden emission of blast and coal covered us with soot. Each laughed at the other, not realizing his own absurd plight.

The smelter and its operations are open to many obvious criticisms, the chief being the apparent failure to take advantage of the lessons offered by the experience, and blunders, of the copper miners in Arizona. Thirty years ago the concentration of carbonate ore was attempted at Clifton, and twenty-five years ago the smelting of fine ore in a blast furnace was done at Bisbee. The lamentable results should have served as a warning to our Belgian friends, and to the British and American metallurgists who undertook formerly to guide them, one might add not unfairly. But the fact has to be recognized that the lack of sulphide ore renders the standard American method of collecting the copper in a matte, to be desulphurized in a converter, unavailable in the Katanga. The little sulphide ore that has been found, in stringers and small veins, carries only barely enough sulphur for its own treatment, and the quantity is, as yet, negligible. However, in a region so extraordinarily mineralized as is this part of the Katanga one may expect confidently that eventually large masses of pyritic material will be found somewhere. The finding of them will greatly simplify the metallurgical methods of the Union Minière.

Rich Ore Removed by Picking

The concentrator at Panda has a daily capacity of about 3,000 tons. This yields a 25 per cent concentrate, in the proportion of about five to one, and a 5 to 6 per cent tailing from a feed of about 10 per cent ore. The crushing plant consists of four No. 9 Allis-Chalmers gyratories followed by trommels, which remove the fine; then come six picking-belts; after these the ore is recrushed by small Gates gyratories, followed by rolls. On the belts any pieces as rich as 25 per cent are removed, for direct shipment to the smelter. The crushed ore is conveyed to a bin, where it is moistened, elevated, and screened by trommels. The coarse goes to bull jigs, the fine to Wilfley tables. Rolls intervene between the bull jigs and the Hancock jigs, the tailing from the latter going to ball mills, and thence to Wilfley tables. Three products are obtained: (1) picked ore, (2) coarse concentrate, containing 25 to 30 per cent copper, and (3) fine concentrate containing 23 to 25 per cent copper. The last product is being set aside for the present.

Two natives were at work above each crusher, moving the ore, and four were at work below. Four different belts and launders are in use for picking rich ore, thereby supplementing the defective mechanical concentration. The natives are good ore-sorters. As many as 550 "boys," as the workers are called, are employed daily in this mill.

The ore obviously is difficult to concentrate, because it exhibits every variety of physical condition, from wet clay to siliceous sinter. I saw two carloads of wet concentrate from the Likasi washery dumped into the main bin above the crushers.

A pilot flotation plant is at work, and it is interesting to note that palm oil is used as the modifying agent. This is one of the principal products of the Congo basin, and the use of it reminds one that local oils have been adopted for flotation elsewhere: eucalyptus oil in Australia, camphor oil in Korea, and pine oil in the United States. An experimental leaching plant was started in 1922, with a capacity of 80 tons of ore, 9 to 10 per cent, yielding three tons of copper daily. The tailing is said to assay ½ per cent. One-tenth of the solution is withdrawn, after the Ajo fashion, for rectification in order to prevent an excessive accumulation of impurities. The cathodes are 98½ to 99 fine. One is impressed with the bigness of the plant needed to produce three tons of metal daily. The sulphur required to make the acid comes from the Texas Gulf Sulphur Co. in Louisiana.

The Union Minière has opened up ten mines, of which the Star of the Congo, nine miles from Elisabethville, was the first to be exploited systematically. The pit is 120 ft. deep, and 450 ft. long and wide. At 150 ft. the orebody is bottomed, although in places the copper mineral extends into the fractures in the basal dolomite. The rocks exposed in the pit are shale, flagstone, and dolomite. The orebody is half a mile long, and is limited in depth by a fault plane. The brecciated dolomite is cemented by malachite and chrysocolla. About two and one-half million tons of 5½ per cent ore is exposed. The rich ore now being selected for smelting will last for two years, so I was informed.

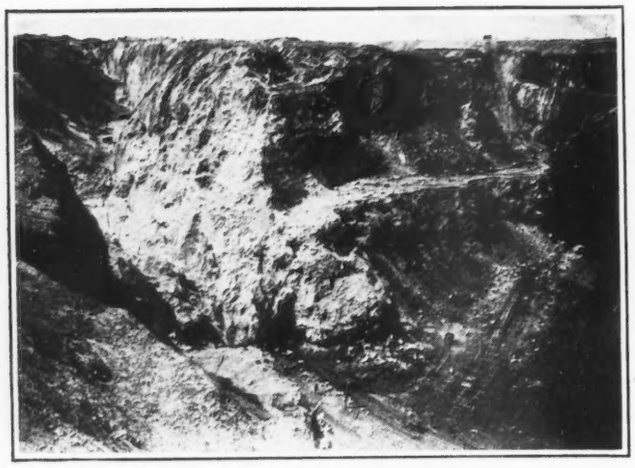
Ruashi Discovered by Drilling

Two miles northwest of the Star of the Congo is the Ruashi mine; the orebody was found by drilling, on the suggestion of old native workings. These, however, were of small surficial extent and did not penetrate far, because ground-water is struck at 23 to 25 ft., so that the natives could not dig below that level. Moreover, except at one place, discovered by the natives, the ore does not come to the surface; it is covered by an overburden, 30 ft. thick, of red loam, which has been stripped. The first stripping was done in August, 1922, and the first shipment of ore was made in July, 1924. The bottom of the pit is at 125 ft., but the ore extends 25 ft. deeper. At the time of our visit the excavation was 2,000 ft. long by 650 ft. wide. High-grade cobalt-copper ore is found in the upper part of the deposit. The ore, all oxidized, occurs as an impregnation in thinly bedded sandstone, much contorted, lying upon dolomite, which is faulted, as at the Star of the Congo. About 2,500,000 tons of 6 per cent ore is exposed. The other rich orebodies, known as the Ruashi No. 2 and No. 3, are being prepared for production.

The Likasi mine is close to Panda. This mine was started in 1918. The ore is 250 ft. thick and averages 10 to 12 per cent. The face of the pit is 190 ft. high,

In the Ruashi mine

It is evident that much hand work is resorted to at this particular property



In the Star of the Congo mine

This gives a good conception of the great depth of the deposits

The holding of the Tanganyika Concessions has diminished to 30 per cent, owing to the fact that this British company did not take its proportion of sundry issues of shares, partly owing to the use of its financial resources in building the Benguella railroad. The market valuation of the Union Minière today is about $150,000,000. It controls a concession of 10,000 square miles.

The first systematic work was done in 1909 at the Star of the Congo mine. In 1911 the first blast furnace was erected near Elisabethville, and two more furnaces were erected in the two following years. A new plant, of four blast furnaces, was erected in 1915, but it was not until after the war, in 1922, that the enterprise got into its stride. In August, 1924, the production of copper by the Union Minière was 9,111 tons, which feat drew world-wide attention to the Katanga as a menace to the copper market.

Two Centers of Activity

The two principal centers of activity are Elisabethville, the seat of administration, and Panda, 88 miles northwest, where a concentrator has been erected. The Lubumbashi smelter, near Elisabethville, is situated in a depression, this unsuitable site having been chosen, by a British metallurgist, with the idea of facilitating a supply of water by gravity. The concentrator at Panda likewise is badly placed; in this case the blame rests with an American metallurgist. An excellent smelter site exists on the ridge that marks the best residential portion of the town. The plant consists of seven blast furnaces, together with one reverberatory, the latter having been started in June, 1924.

At the time of our visit 1,200 tons of 24 per cent copper ore was being smelted in four blast furnaces daily and 250 tons of 23½ per cent ore (with 35 per cent flux) in the reverberatory. We were informed that six of the blast furnaces would be in operation during July. Three of these are 16 ft. by 48 in.; three are 20 ft. by 44 in. The reverberatory is 100 by 15 ft. The blast-furnace slag was averaging about 3 per cent and the reverberatory slag 1¼ per cent. In 1924 the slag from this smelter averaged 3.22 per cent. The reverberatory slag contains 44 per cent silica, 19 per cent iron oxide, 7 per cent alumina, and 20 per cent lime, whereas the blast-furnace slag contains 42 per cent silica, 23½ per cent iron oxide, 7½ per cent alumina, and 14½ per cent lime. The high alumina content of the slag is less objectionable than it might seem, on account of the absence of zinc in the ore. The proportion of coke used is 16 to 19 per cent on the charge, according to the season. The consumption of coke is 13,000 tons per month. It comes from Wankie, in Rhodesia, 734 miles distant. Three-fifths of the coke consumed comes direct from Wankie, the other two-fifths is made at the smelter from Wankie coal. In April it was expected to smelt richer ore during May on account of the shortage of coke; as the supply of coke goes down, the grade of the ore is raised, to maintain the production of copper.

New Sintering Machine Planned

The limestone, of which 400 to 450 tons is used daily, comes from a locality 90 miles distant; it contains 2 per cent silica, and costs 40 francs per ton. The iron flux is obtained from a quarry about 20 miles south of Elisabethville. The ore averages 45 per cent silica; four years ago the silica content was 68 per cent, and the ore then required 100 per cent of flux. The feed is extremely uneven, some of it very coarse, some excessively fine. The ore and flux are bedded in the charge-car at the bins. Two or three tons of 70 per cent matte is made daily, owing to the sulphur in the coke. This matte is broken, crushed, and added to the sintering furnace. For this purpose, a fixed "table," on the Dwight-Lloyd principle, was being used, but a 44-in. Dwight-Lloyd sintering machine of 150 tons' capacity was about to be erected. The fine ore used to be briquetted, but it was found that the briquettes disintegrated in the upper part of the blast furnace. Even the Wilfley concentrate from the mill at Panda used to be fed into the blast furnace, but now the reverberatory alone is employed to smelt such material. The reverberatory can be run with more silica and less flux, and is therefore better suited to the Katanga ore. Another advantage of the reverberatory is the possibility of using cheap coal (30 per cent ash) from Luena, in a powdered form. The Luena colliery, under the same financial control as the Union Minière, is 267 miles distant.

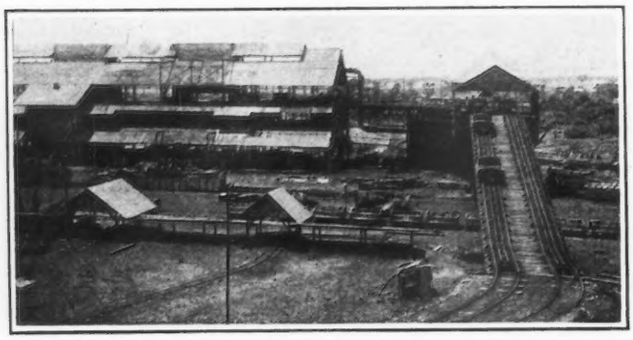
Smelter Employees Number 3,300

Three hundred whites and 3,000 natives are employed at the smelter. Each furnace is operated by sixteen natives under a white foreman. The slug is tapped and granulated by the natives; the metal is tapped by white men. Formerly the slag was discharged into slag pots that were pulled by locomotives to a distant dump, owing to the flat site of the plant; now the slag is granulated and then run into a pond, before being shoveled into a car. The pond is a long one, like a ditch, and is divided into three sections, the water being withdrawn from a section when it has been filled with the granulated slag. In the one that was full of water the native workers were to be seen bathing.

Recovery Only About 80 Per Cent

The smelter-yard is ankle-deep in dust, on account of the fact that no flue chamber is attached to the furnaces. The top of each blast furnace discharges into the air. No less than 150 tons of 12 per cent dust is made daily. The total loss in smelting is 20 per cent; of this 13 per cent is in the slag and 7 per cent in the dust. The final product, of course, is the so-called black copper, 98 per cent, or about 1 per cent below converter copper. The chief impurities are cobalt and iron, together with less than five ounces of silver Powdered coal was being tried in one of the blast furnaces, and when we, with

the rim rising 50 ft. higher in places. The benches of variously colored rock, red, blue and green, make a splendid sight in the sunshine. The ground has been trimmed to look like a series of ramparts, the faces of which are traversed by steeply dipping veins of carbonate and silicate ore. This mine is producing 8,500 tons of 22 per cent ore, for the smelter, and 20,000 tons of 10 per cent ore, for the concentrator. Not 1 per cent



Blast furnaces at the Lubumbashi smelter

Note the charge cars being pulled up the incline at the right.

of the orebody is waste; the base of it lies on a fault plane in brecciated dolomite. On the flank of the open-cut a pocket of copper phosphate was found; more remains, and in a locality favorable for removal to the new leaching plant, the site of which was being prepared while we were there. Some of the ore is washed and sorted, the natives showing much intelligence in the operation. From the top of the hill in which the Likasi pit has been excavated one obtains a wide view of the country over a radius of 60 to 75 miles. The altitude is about 4,000 ft. and no hill in sight rises to higher than 4,700 ft. It is a rolling country covered with dark-green bush, in its primeval state.

At Chituru, two miles from Panda, is a deposit of black shale containing 10 per cent iron pyrite. This is being explored in the hope of finding a body of massive pyrite. The sulphur that costs $20 in the United States costs $100 when delivered at Panda. Half a mile nearer the concentrator is another copper deposit, which has been uncovered as a supply of leaching ore, of which there is 1,500,000 tons of 9 per cent ore. The bottom has not been reached, no drilling having been done as yet.

Kambove Has 4,000,000 Tons of 10 per Cent Ore

Eighteen miles from Panda is the Kambove mine, 4,400 ft. above sea level, where 4,000,000 tons of 10 per cent ore is exposed. About 5,000,000 cu.yd. have been excavated already, the pit being 2,200 ft. long by 1,000 ft. wide in its maximum dimensions. The pit is 220 ft. deep, the bottom of the ore is at 280 ft., and water is cut at 340 ft. The mine is worked in six benches, by means of six steam shovels, three of which were in action at the time of our visit. Of the 1,000 natives at work, 420 were digging ore. The pink and green colors of terraces present a pleasing picture. The ground is much broken by faults, and the bottom of the orebody lies in silicified dolomite. The top of the ore-bearing ground is talcose. As the ore is broken, the best of it is sorted for the smelter, and the remainder, assaying 8½ to 9 per cent, is sent to the concentrator. Four Keystone drills are used, with jumpers and single-hand hammers.

Native workings, at the southeastern end of the orebody, gave the clue to this deposit. The level of the ground-water is 60 ft. below the orebody. Only a mile distant is the Kambove West orebody. which probably is on the same fault. Ore of 16 per cent grade used to be sent from here to the smelter, but when the feed was raised to 20 per cent this mine was shut down. A million tons of 8 per cent ore is said to be exposed. At 190 ft. deep the drill cut sulphide ore of 5 to 6 per cent grade, in veinlets of chalcocite, bornite, and chalcopyrite.

At Luishia, 31 miles southeast from Panda, one obtains a good cross-section of one of these remarkable deposits of oxidized copper ore. It is topped by talcose breccia; then comes 48 ft. of talcose shale, followed by 39 ft. of siliceous shale which becomes a cherty dolomite at its base; then 38 ft. of siliceous dolomite, followed by 100 ft. of dolomite shale, under which comes 330 ft. of dolomite. The impregnation of copper extends throughout these successive formations, which are tilted at 45 deg. The strata are contorted and faulted. The orebody contains 6 to 7 per cent of iron, which is more than is usual in these deposits. A pit 180 ft. deep, 300 ft. long, and 265 ft. wide indicates the spot where a remarkable mass of nearly pure malachite was excavated. About 25,000 tons of 35 per cent ore was obtained. Pieces of clean malachite are sent to Los Angeles, where they are made into ornaments and curios. Fifty tons of this material is sold annually by the company at $1 per pound. A big trench, like a steam-shovel cut, indicates the removal of a band of 20 per cent ore. These workings suggest what a Cornishman would call "picking out the eyes of the mine." There is exposed about 4,000,000 tons of 6½ per cent oxidized ore. Most important are the results of drilling near by, for these show disseminated sulphide, as chalcopyrite, averaging 2.75 to 3 per cent copper, to a depth of 600 ft.

The Proverbial "Mountain of Ore"

On May 4 we made a motor journey on a good road, but over several shaky bridges, to Fungurume, 90 miles from Panda. There we saw a good example of the deposits not yet opened up, but the potential sources of a large tonnage of ore. The prospecting at Fungurume was started in 1918 and finished two years later. The work was done by drilling and by crosscut tunnels. A ridge rises 450 ft. above the flat; the top of this ridge consists of shale, of which 200 to 300 ft. is impregnated with copper. The ore ceases where the brush begins. As one of my companions remarked: "By gosh, it's a wonderful mountain of ore." The estimate, based on the prospecting, is 13,000,000 tons of 8 per cent stuff, but only a fraction of the ground has been tested. High-grade ore is scarce; the deposit is to be treated by leaching, and a plant of 60,000 tons' capacity for this purpose is to be erected in two sections later. The expectation is to use half a pound of acid per ton of ore. An aërial tramway, 11 miles long, will bring similar ore from the Kakanda deposit, which is estimated to have at least 9,000,000 tons available. Near Fungurume twenty-six outcrops have been detected within a distance of 25 miles. This suggests the possibilities of the locality. Here I may say that the western mines, such as Dikulwe, Kolwezi, and Musoni, to which we did not go, are said to be of great promise. Each has from 2,000,000 to 5,000,000 tons of rich ore.

Steam shovels are used for digging, but their efficiency is much impaired by the ignorance of the natives that control their operation. White men are placed on

locomotives, but natives operate stationary hoists. As much as possible of the work of the natives is done on the piece system. Of the total cost of mining, however, only 20 per cent is the cost of native labor. The natives are paid from 80 centimes to 1.75 franc per day, plus food, clothing, and housing. The average cost of these items amounts to 8 francs per day. The food ration per week consists of 15 lb. of mealie, 4 lb. of meat, 2 lb. of rice, 2 lb. of beans, 1 lb. of peanuts or 1 lb. of palm oil, a roll of tobacco and a pinch of salt. The same ration is given to each wife and a half to each child, The Union Minière employs 14,000 natives. These are recruited from regions as much as 600 miles distant; when operations were started in the Katanga the region was almost deserted by its native population, on account of tribal wars, the slave trade, and the climate, which is not favorable to native agriculture, but now the conditions, of course, are vastly improved. Nevertheless, the obtaining of an adequate supply of natives for work at the mines will be one of the difficulties to be overcome as the scale of operations is enlarged. As soon as the natives become sophisticated they find that they need not work for more than a few months to obtain enough money to buy a wife and settle down on a mealie patch. However, as they learn to wear more clothes and buy more luxuries, they have to work longer to be able to buy them. That is the story of indigenous colored labor everywhere.

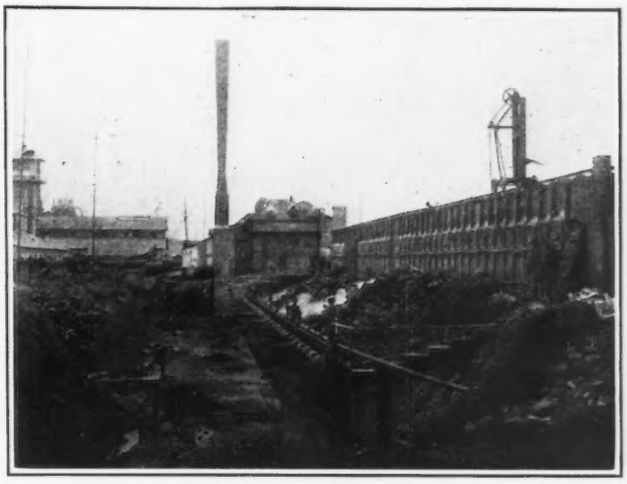
The white employees are engaged for a period of three years, after which a holiday, or *conge*, of six months is granted. Most of them, naturally, are Belgians, it being the aim of the government of that country to find employment for its own young men in these colonial enterprises and to train them for such work. The Union Minière does not maintain the color bar; it encourages the native to learn how to become a skilled worker. The engine drivers on the railroad are natives —and how they love to blow the whistle! Other natives tap slag and use machine tools. In the Transvaal it is illegal—a fine of £500 being imposed—to allow the native to do the work of an artisan, such as carpentering or shoe making, but the Union Minière pursues a much more generous policy, for at Luishia, for example, I saw 180 young natives being taught to do the work of carpenters and smiths. They make office furniture and window frames; they repair cars and boiler tubes. These "boys" are under contract for three years; they start with a pay of 2.25 francs per day, plus food and hut. In their third year they receive 3.30 francs. Such an example of an effort to educate the natives would provoke misgivings among many Europeans in South and Central Africa, for it means a sophistification and mental training that will put the natives on a competitive basis with the whites, and, of course, lead eventually to the demand for political rights.

Sundry other activities at Panda need to be noticed. Three electric furnaces are used principally to reduce cobalt-copper ores, making a copper-cobalt-iron alloy, which is sent to Antwerp for refining. At the time of our visit two of these furnaces were reducing a 25 per cent copper concentrate, getting a 97 per cent metal and a 2 to 3 per cent slag. The energy consumed in this operation is 700 kw.-hr. per ton of copper produced.

Production of Uranium and Cobalt

In front of the office at Panda is a wooden box, with iron straps, in which is five tons of uranium ore, containing 700 mg. of radium, which is worth $75 per milligram. The Union Minière, by reason of its deposits of pitchblende and other uranium ores containing radium, controls the world's market of this precious element. It has killed our American production of uranium ores in Colorado, and has made two of the American companies its selling agents. The pegmatitic dikes, in which the uranium ore occurs, cut across the copper deposits; they contain a higher proportion of radium than any like ores previously known. So the Union Minière controls the market for radium, and possibly will control that for cobalt, at an early date. In its western concession also it has tin deposits, both alluvium and lodes, that promise to be highly productive of another of the metals most needed in modern industry. The Katanga, as a mineral region, ranks with the richest and most diversified ever exploited by man.

The ore deposits are concentrations of copper in sedimentary rocks, a type not uncommon in Western America, although we have none so rich. It has been suggested that the copper was precipitated in the shale, sandstone, and dolomite from descending solutions that had resulted from the leaching of a former overlying formation containing copper sulphides in a disseminated condition. Such an explanation will not find favor today among American geologists. The idea prevails that the copper in such deposits as those of the Katanga represents a concentration of the copper already in the sedimentary rocks, rather than any brought thither from above or below. Waldemar Lindgren, for example, in discussing similar deposits in New Mexico, suggests that they originated by the "concentration of minute traces of copper in certain strata or in fissures by circulating atmospheric waters charged with chloride and sulphate" of copper. He is of the opinion[1] that the copper has been derived from the erosion of earlier



Coke ovens at Lubumbashi

deposits. The copper deposits of the Khirgiz steppes, in Western Siberia, with which I was familiar as a boy, are notable examples of this type. There they occur in the Permian sandstone and appear to have been precipitated by the reducing action of vegetal remains, in this respect resembling the copper found in the plateau region of Utah. B. S. Butler and his colleagues regard these[2] as concentrations of copper that had been disseminated in the sediments. The orebodies are

[1] "The Ore Deposits of New Mexico," U. S. Geological Survey, Professional Paper 68, p. 78.
[2] "The Ore Deposits of Utah," U. S. Geological Survey, Professional Paper 111, pp. 152-153.

compounded of Bantu speech and Arabic, plus additions from various sources, a lingo of a mixed kind somewhat similar in its origin to the Chinook that passes current in Northwestern America. Flemish likewise is a dialect, of a more literary character, but the use of it is regrettable in so far as it makes the Belgians a bilingual people. The natives that have come from Rhodesia to work in the copper mines have brought a smattering of English with them into the Katanga, and are spreading it throughout the region. Most of our Belgian friends spoke English, and liked to do so with us, probably because not each one of our party spoke French and partly because they desired to practice the use of our language.

A few scattered notes may be recorded: Excavation with native labor costs 25c. per cubic yard; the consumption of explosives is at the rate of 200 tons per annum, as against 120 tons per week at the Utah Copper mine. This indicates the difference in the hardness of the ground. Everything that costs one franc in Belgium costs three francs by the time it reaches the Katanga. Power is to be developed at the falls of the Lufira River. The ore may require agitation before leaching, on account of its clayey ingredients, and this may entail larger vat capacity, as well as a greater consumption of power, than either at Ajo or Chuquicamata. Despite the present production, at the rate of about 200,000,000 lb. of copper per annum, the reserves of high-grade ore are being increased yearly. In 1924 the production was 85,570 tons of metallic copper; in the first half of 1925 it was 43,738 tons, as against 36,829 tons in the first half of 1924. Seasonal variation is explained by the washouts on the railroad and the delay in the delivery of coke, as well as other drawbacks incidental to the rainy period of the year. In June the output was 8,544 tons of copper. It is expected that the production for 1925 will be 95,000 tons of metallic copper.

Known Deposits Number 200

There is already exposed 5,000,000 tons of copper, in the form of 7 per cent ore—say 70,000,000 tons. Of the 200 deposits that have been discovered, only ten have been developed into mines. The probability of finding many more large and rich deposits is unquestionable. The copper belt is 200 miles long by 50 miles wide; it has a course of 30 deg. west of north, and is well within the limits of the concession.

The copper is shipped to Europe and America; half of it is going to the Nichols refinery in New York; the remainder to England, Germany and France. The cost of transport is high of course. Most of the copper is shipped over the Rhodesian railroad to Beira[5], in Portuguese East Africa, a distance of 1,619 miles, at a cost of $50, to which must be added the ocean freight of $8, making a total of about three cents per pound.[6] Some of the copper is going by way of Dar-es-Salaam; this involves many delays on account of the transfers from railroad to boat at Bukama, from boat to railroad at Kabalo, from railroad to steamer at Albertville (on Lake Tanganyika), from the steamer to the train at Kigoma. The freight rate is $46 (£9 5s.) to Dar-es-Salaam, so that the total cost of transport to the refinery is $54, or 2.7c. per pound. This makes it evident how necessary is the outlet to the west coast, at Benguella, on Lobito Bay. A railroad from this point to the Katanga is being built by the Tanganyika Concessions, under the leadership of Robert Williams, who has been the motive force behind the enterprise for twenty years.

The distance from Elisabethville to Dar-es-Salaam is 1,750 miles; to Beira the distance is 1,619 miles; to Benguella only 1,120 miles, a saving of 500 miles as compared with either of the existing routes. To this must be added a saving of 2,700 miles in ocean transport. The Benguella railroad has been built for 400 miles, to the Kuanza River, in the Portuguese territory of Angola, and is now being extended to the Katanga border, a distance of 320 miles. There will remain 400 miles more to be built to Chilongo, the junction with the Katanga railroad. It is expected that the Benguella railroad will be completed at the end of 1927. The Katanga section, from the border to Chilongo, will be built by the Belgians. Meanwhile the Belgians themselves are planning an all-Belgian railroad outlet to the west coast at the mouth of the Congo; they are building a railroad from the present rail-head at Bukama, 392 miles north of Elisabethville, to Matadi, across the big bend of the Congo, a further distance of about 950 miles. Thus eventually, there will be four exits from the Katanga mines to the sea. Evidently beneficial competition will not be lacking.

Among the plans for enlarging the plant, and increasing the production, in the near future, is the erection of four reverberatory furnaces, each of 400 tons' daily capacity, at Panda. No dust chamber, however, is planned for these. The new leaching plant is expected to yield 30,000 to 35,000 tons of copper per annum; and this plant is to be trebled in due course, so that eventually 100,000 tons of copper is to be obtained by leaching, with as much more by concentration and smelting. The refinery now being built at Hoboken, near Antwerp, is to treat 40,000 tons of metal per annum. The money needed for new plant and equipment has been found, and only shortage of native labor can delay the fulfilment of the plans for enlarging the scope of the enterprise. The Belgians look upon the Union Minière as a national undertaking, which in part it is financially, and they do not seek assistance outside their own people. With this feeling we must sympathize; it is entirely natural and laudable. For my part, and for my two companions, I wish them every success and the complete fruition of their purpose.

I cannot leave this sketch of the operations of the great Union Minière without repeating the expression of gratitude that I, together with my two companions, feel to the officers of the company for their courtesy and hospitality, mental and physical. We are grateful particularly to Messrs. Jules Cousin, A. A. Thomson, T. S. Carnahan, Henri Barzin, Eugene Roger, Henri Heymans, R. Howard Hawley, and Charles Janssen.

[5]Recently some of the copper has been shipped out of the country through Port Elisabeth, in Cape Colony, owing to the congestion and lack of facilities at Beira.

[6]As to the total cost of production, I have no official information. It has been stated, unofficially, that the cost is 9½c. per pound.

The Artel Strikes It Rich

A workers' "artel" (independent union of laborers working collectively and sharing the profits) recently discovered extensive deposits of lead, copper and silver ores in the Jetusuisk area in the Semirechye region of the Central Asiatic territory of the Soviet Union, says the *Russian Review*. The ores lie almost on the surface. An assay of ore samples from the deposit showed 60 per cent of pure lead and 30 per cent of copper.

believed to have been formed by circulating waters that collected the metals, not copper only, disseminated in the sedimentary rocks, and deposited them in contact with carbonaceous matter. "The circulation in some places is believed to have been of artesian character and to have been controlled to a large extent by structural features." The metals were derived, it is suggested by Mr. Butler, from the same areas as the sediments—that is, in consequence of the erosion of pre-existing rocks the detritus of which provided the material both for the sedimentary formation and the copper it contains. In reviewing the occurrences of copper ore in sedimentary rocks, Lindgren says confidently[3]: "The epigenetic character of the copper deposits in sandstone is proved beyond reasonable doubt." As to the source of their copper, he says: "Considering the evidence as a whole, the sedimentary deposits must have contained finely divided copper ores, in part from solutions derived from the land area, in part as cupriferous detritus." It remains to say that pseudomorphs of limonite after pyrite have been found in the Katanga deposits.

The topography of the region geologically is that of a peneplain, the consequence of long-continued denudation; the country has an undulating contour, without high ridges. The bending, contortion, and fracturing of the sedimentary rocks provided the structural conditions favorable to the circulation of the ground-water, and the fault planes presented barriers to that circulation, thereby causing the concentration of the copper in orebodies of unusual richness.

Signs of Haste in Opening Deposits

Speaking generally, the mines show signs of having been opened by an experienced engineer, T. S. Carnahan, formerly with the Utah Copper Co., at Bingham, Utah; but the urge to obtain high-grade ore for the smelter and the inability, at present, to treat the low-grade ore have caused the scheme of mining to suffer, so that the excavations are not as systematic as otherwise they would be. Five years ago only a few years' supply of high-grade ore was assured, but since then the company's resources in this respect have been enormously increased. Nevertheless, the mines will not be on a proper footing, and cannot be exploited satisfactorily, until the more adequate metallurgical equipment now under construction has been provided. Here I may make note of the fact that the equipment is defective partly because it was assembled hurriedly during the war at a time when it was extremely important to produce copper for the making of munitions; in short, the technical efficiency of the plant was sacrificed, measurably, to the urge for aiding the great cause to which Belgium was so courageously committed.[4]

In our excursion to Fungurume we traveled in a Renault car, with balloon tires, driven by the assistant manager, Henri Barzin, who drove like Jehu, the son of Nimshi, but with such skill as to allay our fears. A Ford car followed us with the luncheon and a man to repair the bridges. When we came to a bridge of doubtful safety we let "Henry" lead the way. That reminds me that when descending the Upper Congo River, two weeks later, we met two Frenchmen making the tour from Oran, in Algeria, to Cape Town, the whole length of Africa, in Citroen traction cars. They also used the humble Ford to lead the way, and had themselves photographed in the long grass, without their pioneer, to show how they penetrated the wilds. To add insult to injury they took a photograph of good little "Henry" in a creek being pulled out of trouble by a Citroen!

When we started for Fungurume in the morning, the brush was wet with dew, and as we passed the overhanging tasseled grass sprinkled us with cold water. Anybody on foot making his way through the brush would soon become wet and cold. When we climbed the hills at Fungurume it was blazing hot. We wore the topee, or pith helmet, and also a red undershirt, to protect us from the actinic rays of the sun. After our examination of the outcrops we rested under a big tree and enjoyed a luncheon that included cold beer, canned partridge, and apples from the Cape—not so bad for Central Africa.

Prices of Gasoline and Champagne

On our way back we stopped at the house of a former priest, Mr. Le Noir—a curious name in a country of negroes. From him we obtained some gasoline, and while there, replenishing our supply of petrol, we were treated to a bottle of champagne, which we were told had cost 23 francs, when imported several years ago. The gasoline cost 25 francs per gallon, and the champagne 23 francs per quart! Which is the evidence of the more advanced civilization? Our host proposed the toast: "My compliments to the dry men"—as if to laugh at our Eighteenth Amendment! On leaving the house I picked up a pipeful of tobacco from leaves that were drying in the sun.

Elisabethville is an attractive town, at an altitude of 3,900 ft.; it can boast many charming homes, including the Governor's residence, to which we were invited on the occasion of a formal dinner, a function that was performed in a manner to excite our admiration and to make it difficult for us to believe that we were in the midst of the African wilderness. The social centre of the community is the club, the Cercle Albert-Elisabeth, named after the King of the Belgians and his gracious consort. In the environs of the town are gardens and farms, the cultivation of which is rendered difficult in places by the ant hills; the removal of these and the leveling of the ground has to be done laboriously; one ant heap may represent as much as 1,000 cu.yd. of hard earth. Among the fruits cultivated are bananas, oranges, lemons, and tangerines. Speaking of ant hills, I may mention the nine-hole golf-course, the hazards of which consist of these termite cones; but even more tinged with sadness is the fact that the greens are made of pulverized slag containing 3 per cent of copper. Even to a pseudo-metallurgist, like myself, it was positively tragic to play the little innocent white ball over slag so rich in copper!

Happy and Contented Prisoners

While sitting at *dejeuner* at the Bruxelles hotel one day we saw a hundred native prisoners, clad in striped yellow-black jerseys, file past in the street; they were chained in groups of six, after the style in which slaves used to be driven across the continent. Prison life to them means little, however, because they are treated humanely, and are fed and housed better than when at their own homes.

Four languages are spoken in the Katanga—French, Flemish, English, and Swahili. The last is a dialect

[3] "Mineral Deposits," by Waldemar Lindgren, p. 375.

[4] Nor, I may add, is rich ore conducive to technical precision of method.

Consultation

South Africa Without the Gold Premium

"Generally speaking, how have the gold mines of the Rand, in South Africa, fared since the disappearance of the gold premium?"

The following extract from the latest report of the Consolidated Goldfields of South Africa gives some pertinent data on this subject:

"The outstanding feature affecting the gold-mining industry during the year under review [the twelve months ended June 30, 1925] has been the final disappearance of what is known as the 'premium on gold,' which has been so important a factor to the revenue of the gold-mining companies for some years past. The importance of the additional revenue from this source during these years can hardly be overstated. It came at a time when, owing to the ever-rising costs resulting from war conditions and other causes, many mines were faced with the prospect of having to close down, and the continuance of the premium until the early part of this year proved of great assistance to the industry during the critical period referred to. For some time past, however, it has been the aim of those controlling the gold-mining industry to organize and prepare for the return of gold to par value, and it is highly satisfactory that the industry has been enabled since 1922 to bring about efficient conditions on the mines and to effect such reductions in cost of production as have prevented dislocation of operations which would otherwise, without doubt, have been the case, especially on a number of the lower-grade mines.

"The following are the comparative results obtained on the Witwatersrand gold mines during the past two years:

	Twelve Months Ended June 30, 1924	1925
Tons crushed	27,335,410	28,392,781
Yield in fine ounces	8,979,955	9,319,833
Total revenue decalred	£41,219,538	£40,678,419
Working expenditure	£27,031,225	£27,368,991
Profit on working	£14,188,313	£13,309,428
	Per Ton Milled	
Revenue	30s. 2d.	28s. 8d.
Working costs	19s. 9d.	19s. 3d.
Working profit	10s. 5d.	9s. 5d.

"It will be seen that while the scale of operations for last year shows an increase, there was a decrease in the working profit due to the falling away of the premium on gold. The actual loss of the premium, taking the net price of gold at 84s. 9d. per fine ounce, as compared with the average price during the twelve months ended Dec. 31, 1924, of about 90s. 9d., is 6s. per fine ounce, which is a serious loss to the low-grade mines and can be only made good by further reductions in working costs.

"The reductions in working costs since 1921 have been as follows:

Twelve Months Ended	Average Working Cost per Ton on Witwatersrand Gold Mines	Reduction per Ton as Compared With 1921
Dec. 31, 1921 (pre-strike period)	25s. 8d.	.....
June 30, 1923	20s. 4d.	5s. 4d.
June 30, 1924	19s. 9d.	5s. 11d.
June 30, 1925	19s. 3d.	6s. 5d.

"With the resumption of the gold standard, it is reasonable to expect that commodity prices will gradually reach a lower level, and with the return of more prosperous conditions in the Union of South Africa, the present railway charges would appear capable of reduction. The prospect, however, of a further material reduction in working costs in the immediate future is to a great extent dependent on an ample supply of native labor and the possible effects of legislation which has been, or may be, introduced by the government of the Union of South Africa."

The Lowest-Grade Mines

"I am interested in data on mines producing ores containing very little metal. I should be much obliged to you for your answer to the following:

"1. Which gold mine is at present operating with the lowest-grade ore?

"2. Same question about silver mines where only a non-important part of the value is in other metals?

"3. Same question about copper mines?

"4. Same question about lead mines?

"5. Same question about zinc mines?"

Answering these questions presents several difficulties. For example, how much silver and gold in a copper ore can be considered "non-important"? However, the following answers are given provisionally, with the suggestion that we will be glad to have readers make any other nominations that they have in mind.

1. Alaska Juneau. The gold value of the ore as mined in 1924 was 87c. per ton. The recoveries for the year were as follows: gold, $1,907,373.55; silver, $42,501.72; lead, $105,906.62. This comes pretty close to being a "gold" ore. If Alaska Juneau were eliminated from consideration, the place might fall to one of the South African mines, perhaps Crown Mines. Some of the low-grade mines in Mexico, as, for instance, those of Guanajuato and El Oro, derive a good part of their income from silver.

2. Fresnillo. Here the Mexican Corporation is milling ore that contains only about 5.25 oz. of silver per ton. There is very little gold in the ore. Second place might go to a Cobalt property.

3. Utah Copper. During the third quarter of this year the average copper content of the ore milled only 0.99 per cent copper. There is an appreciable revenue, amounting to about 0.8c. per pound of copper, from gold and silver in the ore. Second place probably would go to one of the Michigan producers. In 1915 much of the ore mined in Michigan averaged less than 20 pounds per ton, but only ore of higher copper content is being mined at present. Miami has started mining its low-grade ore, and may soon take first place in the low grade of mill heads.

4. St. Joseph Lead Co. Most lead ore contains silver; and in southwest Misouri the lead may be considered a byproduct of zinc. Southeast Missouri, where the St. Joe company operates, is one of the few districts in which lead is virtually the only profitable metal in the ore. The ore as mined ranges from 3.5 to 4 per cent lead. Incidentally, about 27,000,000 lb. of lead is being produced each month, which makes nearly if not quite the largest non-ferrous metal mining enterprise in the world from the standpoint of volume of production.

5. Mascot in Tennessee. At these mines of the American Zinc, Lead & Smelting Co. the ore contains from 3 to 4 per cent zinc and virtually no other valuable metal. About 2,000 tons per day is being mined and milled by highly efficient concentrating methods.

News of the Week

The Mining News of ENGINEERING AND MINING JOURNAL-PRESS is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Summary

TILSON resolution providing for investigation of commodities under foreign control includes tin, chromium, quicksilver, and nitrates.

Anaconda timber-framing plant destroyed by fire—Barnes-King dissolves—Butte Copper & Zinc ships 9,000 tons zinc ore per month.

Alaska mines taking on new life; ambitious dredging plan for Fairbanks district; cold water thawing at Nome.

Patagonia district, Arizona, active as old properties are reopened.

Ahumada Lead Co. moves main office to Pasadena, Calif.—Miami Copper reduces mining costs—Calumet & Arizona builds new hoist house.

Pittsburg Silver Peak operated by lessees—Tonopah Divide resumes shipments—Leadville Mines Co. leases its property.

Research Council of Canada to study magnesite deposits—Ontario November gold production $2,336,278—Noranda developments satisfactory.

Michigan Copper production in December 13,850,000 lb.—Low-grade iron deposits to be mapped.

Surplus of labor at Ontario mines; ample supply in British Columbia; sliding scale wage satisfaetory in Missouri.

Proposals to reorganize Camp Bird, Ltd.—Annual report of Mexican Corporation disappointing to London.

Idaho Public Utilities Commission Decides That Tailings Be Classed as Crude Ore

On Dec. 19, 1925, the Public Utilities Commission of the State of Idaho rendered its decision in the case of Harr & Harr, partners, vs. the Oregon-Washington Railroad & Navigation Co., involving the proper classification of material shipped from a tailings reservoir to a mill and smelter at Bradley, Idaho. Harr Brothers contended that the tailings they shipped was ore and as such should take the lowest freight rate, while the railroad company classified the material as concentrate and so billed the cars and assessed the freight.

From the evidence submitted it appears that the material shipped, the classification of which was in controversy, came from the workings of mines in that district a number of years ago; that the product taken from these mines was worked, milled, and treated according to the methods then in use, and all value was saved that could be saved. The residue from the mine, which was regarded as waste material, was discharged into a creek, and by the action of the water was carried to a point where a dam had been constructed in the creek, forming a tailing pond, and the crushed rock and waste was deposited in this pond. This material had remained as thus deposited during all the years since the working of these mines, which began about the year 1898, and was regarded as waste material. Recently, however, it has developed that there are values contained in these deposits, which, according to evidence, average about $5 per ton, and which, under the present method of handling and treating ore, are susceptible of being saved, and complainant began the shipping of the tailing, or a portion thereof, to a smelter at Bradley.

The case resolved itself into a determination of what constitutes the three different classes of commodities defined in the defendant's classification; whether the commodity shipped is crude ore, and, if so, whether it is less in value than $20 per ton, or whether it is concentrate. These three items in controversy represent three different rates of transportation. Evidence was submitted and authorities were quoted defining both ore and concentrate, all of which supported the contention of the plaintiff, that the material shipped is "crude ore," and that the commodity shipped by the plaintiff over the lines of the defendant, between July 21, 1924, and Dec. 8, 1924, inclusive, is "crude ore of a value less than $20 per ton," and should be classified as such under the Union Pacific tariff 6019-A, providing a rate of 30c. per 2,000-lb. ton.

First-Aid Training Popular in Alaska

THE interest and enthusiasm manifested by mine operators and miners in Alaska in the first-aid and training work of the U. S. Bureau of Mines, is evidenced by the fact that 141 men, constituting 33 per cent of the total employees of the Kennecott Copper Corporation, have recently taken the training. At the Erie mine of this company 17 men, representing 100 per cent of the employees, received first-aid instruction from Russell G. Thornburg, foreman miner, Mine Rescue Car No. 11.

Anaconda Timber-Framing Plant Destroyed by Fire—Loss $150,000

Because of the breaking of a hot-air line in the boiler room, a recent fire completely demolished the timber-framing plant of the Anaconda Copper Mining Co. at Rocker, Mont. The quick action of the mill crew, railroad men, and the Butte fire department, saved the outlying buildings and a large quantity of finished timbers. The Rocker plant was the largest of its kind in the West, having a capacity of over 50,000 timbers per month. It was built in 1901 and consisted of boiler rooms, a cutting department, and two huge framing machines. The plant had about 75 yards of frontage between the tracks of the Butte, Anaconda & Pacific, and Chicago, Milwaukee & St. Paul railways, the building being one story, with basement.

Railroad crews coupled ten cars of finished timbers, some of which were afire, and pulled them away from danger. Most of the 75,000 stulls on hand were salvaged. The loss was about $150,000, fully covered by insurance.

The burning of this plant might have seriously affected activities at the Butte mines had it not been for the co-operation of the W. A. Clark interests, who, at the request of W. A. Clark, Jr., and J. C. Phillips, placed at the disposal of the Anaconda company, the Clark framing plant, known as the Western Lumber Co., at Bonner, Mont. W. B. Daly, general manager of the Anaconda company, stated that through the kindly action of the Clark interests, sufficient framed timber will be available, so that no suspension of mining operations will be necessary, pending reconstruction of the plant.

Flotation Plant to Be Built for Maxville Company in Montana

The Maxville Gold, Silver Mining & Development Co., Maxville, Mont., is expanding its operations, and will soon sink a deep winze from its tunnel level. Contract for larger equipment, such as electric compressor and other apparatus, has been given to the Butte Machinery Co., and the machinery now is being installed by G. W. Quigley, vice-president of the company. During the last few years a substantial body of ore has been developed, and I. O. Proctor, metallurgist, of Spokane, has been employed to design and erect a flotation plant at the property.

Officers of the corporation are Henry Phillips, J. H. Miller, G. W. Quigley, and J. V. Quigley, the latter being on the technical staff of the Minerals Separation company.

Survey of Michigan Low-Grade Iron Deposits to Be Made

Dr. W. O. Hotchkiss, president of the Michigan College of Mines, at Houghton, heads a committee of Upper Peninsula mining men to work out the most practical method of conducting a survey to determine the resources of Michigan in low-grade iron ore. Preliminary work on the survey has been done, but much remains to be accomplished before any reliable estimate of the lean ore supply can be reached, according to L. P. Barrett, state appraiser of mines.

The object of the survey is to determine the location and extent of low-grade iron ore, which will constitute the only source of supply upon the exhaustion of the deposits of high-grade ore now being mined from the four major ranges. According to Mr. Barrett, the Marquette range has the greatest reserve of any in Michigan. At the present rate of depletion the supply from orebodies already developed is sufficient to insure continued operation for forty to fifty years.

Nevada Pyramid Mine Sold

The Nevada Pyramid mine, in the Pyramid Lake district in Nevada, has been sold to the Nevada Mining & Exploration Co., and operations have been undertaken, with Walter G. Anderson in charge. The property was owned by New York interests and the sale was negotiated by Kirby Thomas, of New York.

St. John Mine to Be Reopened for Zinc

Louis Noble, engineer for the St. John Mining Corporation, organized by Colonel T. B. Burbridge, of Denver, and associates, has secured the St. John mining properties and mill at Montezuma, Colo., a few miles from Keystone, on the Colorado & Southern Railroad. Mr. Noble is putting the plant in condition for an early revival. There is said to be a large supply of zinc ore, which is susceptible to new processes. That which was abandoned thirty years ago by the English owners may prove a money maker today.

San Nicolas Mine Resumes Milling

The San Nicolas mine, southwest of Cumpas, Sonora, Mexico, has resumed milling operations. The shaft was recently sunk to the 500 level, from which drifting is being done so that overhead stoping can be started on the oreshoots opened up on the 400 level. The capacity of the mill is about forty tons per twenty-four hours. Plenty of water is now available, so that regular shipments of high-grade concentrates are to be expected. O. L. Neer is the manager of the property.

The Chispas mine is making shipments at regular intervals of about five weeks. A steady plan of development is being followed to assure adequate reserves of milling ore.

Clark Estate Makes Tentative Payment of $900,000 Inheritance Tax

AGREEMENT has been reached between executors of the W. A. Clark estate and the Montana State Board of Equalization, whereby a tentative inheritance tax payment of $900,000 will be made to the treasurer of Silver Bow County, Mont. The agreement carries the understanding that if, after later adjudication, the court determines a greater tax shall be due, it will be paid, and if lesser there will be a refund. The county treasurer will issue a receipt and turn the money over to the state. According to the inventory of the appraisers of the estate, $16,000,000 of holdings are taxable in Montana.

Bunker Hill Vein Good on 18 Level

The Bunker Hill & Sullivan lead-silver orebody, at Kellogg, Idaho, has recently been struck on the 18 level, which is 1,800 ft. below the Kellogg tunnel, the main operating adit, and found to be equal in grade and size of the oreshoot on the upper levels. This new level is 4,000 ft. vertically from the surface and over a mile from the apex on the dip of the vein. Crosscutting on the 17 and 18 levels has also resulted in important ore disclosures on what is known as the Francis-Barr vein system, which has a record of practically uninterrupted production for more than forty years.

Leona Metal Mines Co. Incorporated

Incorporation of the Leona Metal Mines Co., Victoria, Tamaulipas, Mexico, by a group of Tampico men, including a number of Americans, is announced. The company has taken over the Santa Engracia lead-silver mine, situated in the State of Tamaulipas, and is preparing to install modern machinery and equipment with the view of operating the property on an extensive scale. Among the incorporators are J. T. Fly, R. G. Mead, and L. Kirkendall.

Ample Labor Supply in British Columbia—Sliding Scale and Bonuses Paid

The supply of labor in British Columbia has been ample, and during the winter, owing to the seasonal closing of some properties, there is an oversupply. Harmony has been the rule between employed and employer. The wage scale varies slightly in different parts of the province; roughly, it may be placed at $4.75 to $5.75 for miners and mechanics and 50c. per day less for muckers and above-ground laborers. These figures are reached in different ways. The Consolidated M. & S. Co., for example, which is the largest employer of labor, pays on the basis of $3.50 for miners and mechanics and $3 per day for muckers and laborers, with a living allowance of 50c. and metal bonus, based on the price of lead and zinc in London, which amounts to about 90c. per day, for all classes of labor. It also gives efficiency bonuses for efficient work, and, to induce prolonged employment, gives one share of its capital stock to married men and half a share with the privilege of purchasing the other half at par to unmarried men for three years' continuous employment. Some of the copper companies give bonuses varying with the price of copper. About 10,000 men are employed in the metal mines, smelters, and quarries, of British Columbia and about half that number in coal mines.

Cleveland-Cliffs Iron Co. Sues Struthers Furnace Co.

A suit was recently filed in circuit court in Duluth, Minn., by the Cleveland-Cliffs Iron Co. against the Struthers Furnace Co., Struthers, Ohio; Hugh M. Grant, receiver of the Struthers company, and the Guardian Trust Co., Cleveland, Ohio, to recover $58,755.69 alleged to be due for operating expenses of the Wade mine, near the village of Kinney, on the Mesabi range. The Cleveland-Cliffs company leased the Wade mine from the North Star Co., of West Virginia, for a period of 30 years, paying $44,069.17 cash and agreeing to pay a yearly royalty, on iron ore mined, of not less than $80,000. Later a contract was made with the Struthers company to operate the mine jointly, each paying 50 per cent of the operating expenses. The Struthers company went into the hands of receivers three years ago, and the Wade mine has not operated since 1921.

Craig Mining Co. to Operate Brewer Group

James La Fountain, Stanley S. Craig, and associates have organized the Craig Mining Co. to operate the "Brewer" group of claims in south Butte, Mont. A contract has been given to the Butte Machinery Co. to furnish an electric hoist, an air compressor, and other equipment. Foundations, to set this machinery, are now being built.

The company expects to unwater and deepen the present shaft and also to acquire other properties in the Butte district.

Gilbert-Mammoth Last Hope Reports $37,000 on Hand

The annual stockholders' meeting of the Gilbert-Mammoth Last Hope Mines Co., the pioneer company in the Gilbert district, 30 miles westerly from Tonopah, Nev., was held in Tonopah on Dec. 7. The treasurer's report shows cash receipts from the sale of ore during the last year of $7,096, and cash on hand as $37,000. There are 2,262,402 shares of stock issued, with 702,598 shares in the treasury.

Total development to date is approximately 1,760 ft., which includes 438 ft. of shaft sinking. Lateral work from the 300-ft. incline shaft on the Mammoth, and the 112-ft. vertical shaft on the Last Hope claim, has disclosed some ore, and the manager's report indicates further ore possibilities with depth. It is planned to sink the incline shaft to 400 ft. and drift on the vein at that depth.

Leadville Mines Co. Leases Its Property

The Leadville Mines Co., operating near Gerlach, Nev., has abandoned the plan to construct a selective flotation plant, to replace the one destroyed by fire last year, as at present impracticable for the tonnage the mine is able to deliver, and has placed the mine on a leasing basis, the ore to be shipped to Utah smelters.

The orebodies in the Leadville mine are narrow but of considerable lateral extent, and in the past it has been difficult for the company, on company operation, to furnish a regular tonnage of clean ore for the mill. By leasing the mine in blocks it is believed that cleaner good shipping ore will be obtained, with better profit to the company than by construction of a milling plant and attempting to furnish a regular tonnage for its operation. Development work on 850 and other levels will be continued by the company, and power, equipment and supplies will be furnished by the company for leasers.

Jib Consolidated Finds Faulted Vein

Jib Consolidated, at Basin, Mont., has opened a vein in its East Katie property, this vein being the faulted portion of the main Hope-Katie vein. Ore assays between $12 and $20 in gold and is being trucked to the mill.

Another strike of "picture" rock has been made in the vicinity of the "411" raise below the 400 level, west, of the Katie workings. A little over a year ago 700 lb. shipped from this raise gave smelter returns of better than $11,000.

Consolidated Mining & Smelting Co. Pays Dividend No. 43

The Consolidated Mining & Smelting Co. of Canada, Ltd., announces that a dividend of 3 per cent on the paid-up capital stock of the company for the six months ended Dec. 31, 1925, and a bonus of $5 per share has been declared, payable on Jan. 15, 1926, to shareholders of record at the close of business on Dec. 31, 1925.

Reduction in Mining Costs Obtained by Miami Copper Co.

The Miami Copper Co. has completed all the necessary changes in its mill to handle 10,000 tons a day. The mill has now been treating this tonnage for several months, putting through ore which averages a little under 1 per cent copper. By changing the mining method from the undercut caving system to the incline raise system, similar to that of Inspiration, and making other improvements, the company has succeeded in obtaining an exceedingly low mining cost. It is said that during recent months the mining cost approximates 40c. a ton, including development. It is also stated that the dilution of ore with waste is exceedingly small, owing to the adoption of systematic methods of drawing off the ore.

Calumet & Arizona Builds New Hoist House

THE Calumet & Arizona Mining Co., Warren, Ariz., will start the erection of a new hoist building early in January, to house the giant hoist which has been purchased and is to be installed at the Junction shaft by April, 1926. Workers have begun tearing down the old power house at the Oliver shaft, shut down now for a number of years, and the material will be used in the building of the new hoist house. This will be built directly in the rear of the present turbine building.

Silver King Declares Extra Dividend

Directors of the Silver King Coalition Mines Co. have declared a dividend of 10c. a share to be paid on Dec. 24, and one of 25c. a share to be paid on Jan. 2, 1926, to stockholders of record Dec. 15. This disbursement, totaling $425,635, will bring the Park City, Utah, mines' total dividend record up to $22,846,860.

The Christmas dividend is an extra dividend. That of Jan. 2 will be the regular dividend for the first quarter of 1926. During 1925, the company paid two dividends of 20c. a share each for the first and second quarters and two dividends of 25c. each for the third and fourth quarters of the year.

Pittsburg Silver Peak Operated by Lessees

Lessees have been working in the Mary mine, of the Pittsburg Silver Peak Gold Mining Co., 40 miles southwest of Tonopah, Nev., for several years, with varying results. At present the leasing company has about 600 tons of $50 gold ore broken, which is to be shipped at once, partly to smelters and partly to Tonopah mills.

The Pittsburg Silver Peak Co. equipped this property with a 120-stamp mill in 1909, which was operated until 1914, when it was finally closed down and dismantled.

Silver Shield Mining Co. Opening 900 Level

Drifting operations have been started on the 900 level of the Independence mine of the Silver Shield Mining & Milling Co. adjoining the Tintic Standard at Eureka. At 688 ft. the shaft passed through the rhyolite and entered the Ophir formation, with which the ore is associated in the Tintic Standard.

At 900 ft., when the quartzite contact was entered, the company sunk a sump and built a 16x16x12-ft. station. Drifting has been started both to the northwest and the southeast along the contact to explore important fissure intersections.

Huronian Belt Developing Its New Claim

The Huronian Belt Co. is preparing for an aggressive development campaign on its recently acquired claim W J 9, in the Gowganda silver area of north Ontario. The property lies within the Keewatin and overlies the diabase sill. Diamond drilling has shown the diabase to be within less than 300 ft. of the surface. A mining plant of medium size will be installed at once, which will enable a shaft to be sunk through the Keewatin to a point 50 or 100 ft. in the diabase, where lateral work will be concentrated for the time being.

Michigan Copper Production in December 13,850,000 Lb.

Refined production in the Michigan copper district in December is estimated at 13,850,000 lb. Calumet & Hecla Consolidated produced 8,400,000 lb. Despite the fact that copper now must be moved by rail, the metal business continues brisk. Deliveries are keeping pace with production, which is quite unusual for this time of the year. The bulk of the metal is going to the Mid-West and New England. Until recently the Mid-West, particularly the automotive centers, provided the best market for Lake copper, but New England now is taking almost an equal amount. Export business continues negligible. Belgium and France have taken some copper, but Germany is practically out of the market so far as Michigan metal is concerned.

Seneca, in the Michigan copper district, now is shipping between 700 and 800 tons of rock daily to the mill. Seneca's chief difficulty at present is in obtaining miners. The Mohawk continues at mill capacity, and stamping occasionally on Sunday is necessary. Rock shipments are averaging 2,500 tons daily. No. 6 shaft, the richest unit, is contributing approximately 1,200 tons. Three regrinding units are in operation at the mill and the fourth will be completed by spring.

Arcadian Consolidated's crosscut from the 1,250 level of the New Arcadian shaft is just entering the Allouez conglomerate lode. A little copper has appeared in the hanging side, but further work will have to be done to determine whether the vein contains values.

Washington News

By Paul Wooton
Special Correspondent

Tilson Resolution Provides for Investigation of Commodities Under Foreign Control

Passage of the Tilson resolution, providing for a Congressional investigation of essential commodities under foreign control, means that the inquiry will go forward promptly while greatest public interest will center on rubber and coffee, the investigation of tin, potash, nitrates, quicksilver, and iodine will be conducted just as thoroughly, it is believed, as a separate subcommittee for that purpose probably will be chosen from the membership of the Committee on Interstate and Foreign Commerce.

While such control as has been exercised over the mineral commodities has not resulted in price advances in any way comparable to those which have taken place in rubber, the feeling on Capitol Hill is that the evil will grow rapidly if no effort is made to check it. Lured by the enormous profits being made in rubber, three governments now are said to be considering an agreement which will permit similar action with respect to another commodity which requires such an understanding before control could be effected.

No Satisfactory Substitute For Tin

In the case of tin no satisfactory substitute has been found for tin content of solder. A portion of the tin can be replaced by cadmium, but any such change of practice frequently adds to cost. Tin plate has no substitute when used for most canning purposes. Facts along such lines as these will be developed by the subcommittee if present plans go through.

Italian And Spanish Governments Interested in Quicksilver

Much of interest is expected to come out of the inquiry into the quicksilver situation. The Spanish and Italian governments have a much more direct relationship to that commodity than is the case with the others. The interest in that part of the study will be confined largely to the principle involved, as mercury is regarded as passing out of essential classification. The Navy Department and the Bureau of Mines each is agreed that mercury no longer is a necessity of war. Other detonators now are available. It is estimated that 1 000 flasks per year are necessary for the recovery of gold that is too coarse to be cyanided. This situation would change decidedly however if the use of mercury in boilers were shown to make possible material reductions in the cost of power.

Nitrates and Pyrite Essential in Fertilizer Industry

The committee will not be called upon to do much original investigating as to the control of nitrates. This matter has been reported upon with great thoroughness in connection with efforts to establish a synthetic nitrogen industry. Not the same attention, however, has been paid to iodine, which is subject to the control of the same interests. Were iodine marketed at the lowest price that would allow a fair profit it would be used extensively in metallurgical operations, it is contended.

The control of potash is another subject concerning which all the facts are known. In that case, it is pointed out, the committee would have an opportunity to recommend the prompt passage of the measure proposing the appropriation of $1,000,000 to be used in the search for potash deposits in the United States, and in studies looking to its recovery when in combination with other substances.

It is not unlikely that an effort will be made to extend the list of the commodities to be investigated. Chromite, phosphate rock, and pyrites may be added to the list.

Chrome Ore Largely Under Foreign Control

In the case of chrome ore it is the understanding that the monopoly is broken, but even then there is only one company standing between American consumers and the possible arbitrary action of those in control of the bulk of the supply. Moreover, chromite has particular importance just at this time, in that it will be used in much larger quantities if the new German process of adding it directly to steel proves practicable, as is claimed.

Intensive research is being done at this time in an effort to find a solder which will bind chromium plated surfaces. It is believed the problem will be solved; whereupon, another large new use will have been created.

Pyrite involves a somewhat different problem, but cheap pyrite is regarded as having an important bearing on the fertilizer situation. It constitutes an assurance against excessive prices for sulphur, fertilizer manufacturers point out.

Still another phase of government participation in the manipulation of a commodity is had in Moroccan phosphate. Domestic producers of phosphate rock claim that they are the victims of unfair competition in their export trade.

Ahumada Lead Moves Its Offices

EFFECTIVE Feb. 1, 1925, the offices of the Ahumada Lead Co., which have been at Warren, Ariz., will be removed to Pasadena, Calif. This order also affects the Erupcion Mining Co., the offices of which were moved to Warren, from El Paso, in 1922. The new headquarters of the two mining companies will be in the Pacific Southwest Bank & Trust Co. of Pasadena.

Word from the Ahumada mine is to the effect that another drift on the new 17th level has cut high-grade lead ore with good silver values. On Jan. 2, 1926, Ahumada will pay a 25 per cent dividend, similar to the four quarterly dividends paid in 1925.

Revival of Mining in Alaska in 1925

Thawing Ground With Cold Water; Hydraulicking on Candle Creek; Large Dredges at Fairbanks

The United States Smelting, Mining & Refining Co. is conducting experiments at Nome, Alaska, wherein cold water is used in thawing frozen ground. Gratifying results have been obtained, and the management is satisfied that dredging operations can be extended to eight or nine months of the year, and that all auriferous ground can be mined to bed rock by cold water thawing. The test was made at Little Creek camp, where about 1,700 points were set 16 to 32 ft. apart. The company's gold production for the year at this camp was small, as the three big dredges did not get to work till September.

An Oakland company has been testing out American Creek for dredging ground. The dredge on Wonder Creek took out $100,000 in ten days. Judge Norton is placing a 2½-cu.ft. bucket dredge on Bonanza Creek, at Norton Bay, to be followed by two others on Ungalik River, each with 5-cu.ft. buckets. About 350 men were employed in dredging and drilling at Nome.

The Keewalik company was the biggest producer on Candle Creek. It operated two dredges and a hydraulic plant, supplied with water through a ditch 37 miles long. Candle Creek has enough dredging ground to maintain operations for twenty to twenty-five years. Production has averaged about $1,250,000 a year for the last four years. The New York-Alaska Mining Co. has sent in a dredge capable of handling 75,000 cu.yd. a month, to be placed on Baer River.

At Fairbanks, the Chatanika Gold Dredging Co. reports a successful season. The Lemon-Whitworth Co., financed in England, has moved its two dredges to Fish Creek, losing the season in this work. The Fairbanks Exploration Co., a subsidiary of U. S. S. R. & M. Co., has entered on an immense dredging project, involving an estimated expenditure of about $8,000,000 and requiring three years in its execution. The company has built administrative offices of concrete at Garden Island, involving an expenditure of $30,000; tested an area estimated to contain 80,000,000 cu.yd. of dredging ground, carrying an average value of 17c. per cu.yd.; constructed a ditch 12 miles long for water supply from Chantanika River; and entered on construction of a high-line ditch 102 miles in length, with two siphons and two tunnels. Hydraulic and power plants are to be installed under the direction of Stevens & Wood, of New York. Plans for dredges are being prepared. The company employed 500 men during the summer of 1925 and expended about $800,000.

New strikes were reported on Kantishna River and Valdez Creek.

Quartz Mines Being Developed

The Willow Creek gold-quartz camp is reported to have had a successful year. The Fern Gold-Mining Co., of Spokane, operating the Fern, Lucky Shot, and War Baby mines, produced

about $550,000. The Gold Bullion, Thorpe, Mable, Talkeetna, and Gold Mint Mines were also producers. Three quartz mines were operating on Mineral Creek, west of Valdez. New discoveries of gold-quartz were reported on Valdez Creek and Chestochina River; also auriferous arsenopyrite on the upper Chulitna. The Chichagof Development Co. shipped about fifty tons of concentrates per month from the old Chichagof mine.

Alaska Juneau is the largest producer in Alaska, with an output of over 10,000 tons a day of ore from which the recovery averages 71c. in gold, silver, and lead, with operating costs of 64c. per ton. On this low-grade of ore the company made profits of from $11,250 to $20,270 per month after providing for all charges. The mill is being altered by substituting rolls for ball mills. The adjoining Ebner mine is to be worked in conjunction with Alaska Juneau. The company's production for the year is valued at about $2,500,000. A plant is being installed at the old Gastineau mine to treat the tailings, which are said to carry from $1.35 to $43 per ton. The U. S. Assay Office at Seattle received in 1925 $4,500,000 in gold from Alaska points.

The Kassan Gold Mining Co. has equipped its property on Prince of Wales Island with a mill and hydroelectric plant. A recent discovery is an orebody of the Premier type at the south end of Salmon River glacier, with gold values of $16 to $18 a ton over a width of 35 ft.

The Kennecott company operated the Kennecott, Mother Lode, and Latouche mines, shipping concentrates carrying from 6,000,000 to 7,000,000 lb. of copper per month from the two former. Production of Latouche was about 1,000,000 lb. of copper per month. Green Butte mine, on Copper River, shipped from 50 to 200 tons a month of sorted ore averaging 45 per cent copper.

The Riverside Mine, at Hyder, was leased to Messrs. Littlegage and St. Clair. The Mountain View, on Salmon River, has been equipped with aërial tram 4,000 ft. in length, a compressor and other machinery and should produce in 1926. A discovery of silver-lead ore is reported from White Pass.

PROSPECTING FOR OIL CONTINUES

Standard Oil of California drilled two wells at Cold Bay, one to a depth of 5,000 ft. The Associated Oil Co. drilled 3,000 ft. in the same field. Both failed to get oil. The Peterson Oil Co. is drilling at Chicaloon; the Superior Oil Co., at Cook Inlet; the General Petroleum Co., at Yakataga; and Sinclair Co. and Chilkat Oil Co. at Katalla.

Butte Copper & Zinc Co. Ships 9,000 Tons of Zinc Ore Per Month

Owing to the good showing obtained on the east end of the vein on the 1,200 (deepest) level of the Emma mine of the Butte Copper & Zinc Co., a vertical winze will be sunk about 200 ft. below the 1,200 and crosscut run to the vein. This corporation, which is a subsidiary of the Anaconda Copper Mining Co., is shipping approximately 9,000 tons of zinc ore and 3,000 tons of "pink" manganese ore per month.

Powder Magazine at Jerome Explodes

WITH a blast felt for nearly 50 miles, and a shattering force that wrecked many windows in the business section of Jerome, a powder magazine of the United Verde Copper Co. exploded on Dec. 20. No lives were lost and no injuries reported from the blast, in which 1,200 cases of powder, valued at $40,000, exploded.

The explosion was felt in Prescott, 55 miles distant, and in Humboldt. The detonation was not loud, but the force of the blast sent a column of dense black smoke into the air for 800 ft. The force of the concussion blew off the walls and roof of a second magazine, a few feet distant from the magazine which exploded, but did not disturb the 1,200 cases of black powder within. The magazine which exploded was in an old office building on top of the hill, 300 ft. above and half a mile from the center of Jerome.

Wages at Nevada Mines

Labor has been just about as required at Nevada mining properties, with some surplus, although skilled miners have been in demand. No strikes of importance have occurred, nor have there been many wage changes. Wage scales do not vary more than 50c. per shift, in the principal districts of the state, from the figures here given: Miners and timbermen, $5.75; pipe and track men, $5.75; muckers and helpers, $5.25; cagemen, $5.25; blacksmith, $6; hoist engineer, $6; surface labor, $5; truck driver, $5.50 to $6; millmen, $5 to $5.50, with higher pay to skilled mechanical labor. Some underground work is done on contract, but the price for this work depends on underground conditions, character of rock, and other local conditions, and no schedule can be given.

Village of Chisholm, Minn., Loses Suit to Become City

After a 117-day trial, a victory was conceded to the mining companies when the village of Chisholm lost its lawsuit to form a city and annex the Fraser mine and location. Petition to form a city was made in October, 1923, and the fight has been in and out of the courts ever since. If the Fraser mine had been annexed a taxable valuation of approximately $8,500,000 would have been added to the present village valuation of $16,000,000.

Missouri Miners' Wages Satisfactory

There have been no labor troubles or problems in the Joplin-Miami district during the year. The daily wage scale fluctuates at the rate of 25c. per day for each $5 increase in ore prices, as nearly as can be adjusted, and has proved, as in other years, entirely satisfactory. The Tri-State Ore Producers' Association has devoted much attention to safety work in the mines, and has met with good co-operation from the miners.

The standard underground wage in Southeast Missouri is $5.05 per eight-hour shift, and contractors make $7 to $9. Common outside labor is $3.80 per day. The tonnage output per man is steadily increasing through the use of power shovels, jackhammer drills, and other labor-saving machines, so that fewer men are employed underground to secure the former tonnage. Nearly all the labor is American and only a few Hungarians remain, and no negroes are employed. Some Illinois coal miners, who were idle on account of the labor union closing down most of the coal mines, attempted to enter the district, but they were not welcome. The district is free from unions.

Ontario Mines Have Labor Surplus—Wages Good and Work Steady

Labor conditions are very satisfactory in the Ontario mining district. There have been no strikes or serious threats of strikes, and the unions are inactive and barely existing. The general prosperity in Ontario mines, as compared with other camps, has resulted in a surplus of men in practically all departments. Wages in the gold and nickel mines are: Machine runners and timbermen, $4.80 for eight hours; machine helpers, trammers, and muckers, $4.24; surface labor, $3.76; hoistmen, $5.04; blacksmiths and steel sharpeners, $4.96 to $6.

The contract system is being used more extensively, and at one large mine this has resulted in average earnings of over $5 a shift. Wages in Cobalt are about 25c. a shift less than the scale given above. The sliding scale of wages was used only in the silver mines during the high price of silver and has been abandoned.

In the nickel mines automatic magnetic picking belts are now used, giving increased efficiency and reduced costs. The McIntyre is framing all shaft timber by machine. Mechanical muckers are being used to a greater extent in the larger mines and two of the mines have installed O'Donovan heating furnaces for normalizing drill steel.

Tonopah Divide Mine Again Making Shipments

The Tonopah Divide mine, at Divide, 5 miles from Tonopah, Nev., after being closed down for several months, under the assumption that it was worked out, is again on the shipping list. Ford Brothers were granted a lease on certain portions of the mine. They have been successful in opening up a considerable tonnage of good ore. Since the middle of July these leasers have shipped more than 1,000 tons of ore, which averaged above $20 per ton. In addition to this grade of ore they have accumulated several tons of high-grade horn-silver ore, which has not yet been disposed of. The Ford Brothers' lease has about six months to run, and in the meantime they are busy trying to take out the ore they have in sight.

Johannesburg Letter

By John Watson
Special Correspondent

Gold Occurrences Reported at Ondundu Otjiwapa, South Africa

Platinum Deposits Discussed at Geological Society Meeting—Dunite Decreases in Value with Depth

Johannesburg, Nov. 24—An occurrence of gold is reported at Ondundu Otjiwapa, 70 miles northwest of Omaruru in South West Africa. The locality is said to be healthy, the winter equal to that of Egypt. For less than a year, three small syndicates of local people have been washing the alluvial gold from the creeks and showing handsome returns. Over 1,300 oz. of gold has been won by sluicing over home-made tables. Some of the small reefs show visible gold, and nuggets have been found, from time to time; one of 8 oz. was discovered. The Kudu Mining Syndicate unearthed five nuggets weighing 7¾ oz., 5½, 2¼, 1½, and ¾ oz. respectively. This district lies about 20 deg. south from the equator, and Omaruru has an altitude of 3,973 ft. above sea level.

The last monthly meeting of the Geological Society of South Africa was held in Johannesburg on Nov. 16. An interesting collection of platiniferous minerals, from the Ural Mountains, was on view; also specimens from the Potgetersrust Platinum Co.'s property. Dr. Percy A. Wagner read a paper, on "The platinum deposits of the Bushveld igneous Complex," which he described as "incomparably the world's greatest platinum deposits." He said that, though some sixty new deposits had been discovered, during the last nine months, in the Lydenburg and Rusterburg districts, only two of them carried platinum in notable amounts, and it remained to be seen whether either of them would prove to be workable. On the deposits of the Merensky horizon, sufficient work had been done to justify the statement that, if the price of and demand for platinum should warrant it, a score of big, low-grade mines could be started immediately. The horizon had been traced, at intervals, for a distance of 90 miles, from the farm Doornvlei No. 612, in the Pietersburg district, to the farm Sterkfontein No. 221, in the southern part of the Lydenburg district.

A report was published on Nov. 24 by the T. C. L. & E. Co., Ltd., re the dunite occurrence on farm Onverwacht, stating that lateral development effected at the 150-ft. and 200-ft. levels indicates that values diminish appreciably. At 100-ft. depth, the average value of the payable zone is estimated at 18 dwt. per ton over a circular area of 50 ft., and on the 150-ft. level at 6.7 dwt. per ton over approximately the same area; and at the 200-ft. level, a contraction of the orebody has taken place, the payable ore being a circular area equal to about 40 ft. in diameter and the average value estimated at about 4 dwt. per ton. It is intended to sink to the 250-ft. level, immediately, and crosscut. The question whether Onverwacht should be floated as a separate company will be decided, later, when further assay results are known.

T. C. Land shares rose, early in the week, from 77s. 9d. to 79s. 6d. then declined in price, closing the week on Saturday with sales at 59s. 6d.

Patagonia District, Ariz., Active

Work at the Big Jim property, in the Patagonia district of Arizona, has been progressing satisfactorily for some time. The shaft has been enlarged from a one compartment and a half to a full two-compartment shaft. A working station has been constructed at the 100 level and heavy rails have been laid throughout the workings. From many checked assays it is reported that the ore will average $25 per ton, with values based on the present price of lead and silver. The ore is easily concentrated, and work is at present being rushed on the construction of a 75-ton mill, which will be of the latest practice of concentration by flotation.

At the American Boy, A. F. Gross of Duluth, Minn., is reported to have expended approximately $116,000 on development work. He is driving a 1,200-ft. tunnel to tap the orebody at lower depth than the shaft attained. Mr. Gross has no partners and is financing the work alone. This property is in the Santa Rita Mountains.

The Chief Mine, owned by the Washington Trading Company (E. E. Bethell, of Patagonia; Bracey Curtis, of Nogales, and Mr. Lindsay, of Los Angeles), which is in the Patagonia Mountains, not far from Big Jim, is to be developed immediately by a group of Los Angeles capitalists, with Howard E. Davis, mining engineer and geologist, in charge.

E. F. Bohlinger, administrator for the estate of the late Colonel R. R. Richardson, is prosecuting development work at the old Hardshell mine, in the Harshaw district, where a new streak of high-grade silver ore has been discovered. The Flux mine is also under Mr. Bohlinger's supervision, and has been steadily shipping high-grade lead-silver ore for the last two years.

The old Mowry Mine, under the superintendency of W. J. Mitchell, mining engineer, is making lead-silver ore shipments from time to time. The Jefferson group of claims in the old Salero district has been a steady shipper for several years.

Penokee Iron Co. Acquires Ore Land in Wisconsin

Approximately 3,072 acres of iron ore land on the Penokee range, south of Mellen, Wis., was transferred by the La Point Iron Co. to the Penokee Iron Co. for a consideration of approximately $31,000, according to deed recently filed at Ashland, Wis., by the Congdon interests at Duluth. The lands have been in the possession of the company for several years, and exploration by the Marengo Development Co. has been in progress since 1916. The deposits resemble those of the eastern Mesabi range, and according to Mr. Congdon the transfer will not mean immediate development work.

Toronto Letter

By Our Special Correspondent for Northern Ontario

Ontario November Gold Output $2,336,278

New Ore in Tough-Oakes Mine—Gold Hill Refinanced—Noranda Developments Satisfactory

During the month of November, 1925, the Department of Mines for Ontario shows a total output by the gold mines amounting to $2,336,278, as compared with $2,353,800 in October. This slight decrease, which in the monthly figures is of little importance, was due largely to changes being made in the Hollinger mill, which reduced the output. This temporary loss will soon be made up as the company increases its output. In the Porcupine camp a total of 242,797 tons was treated, the recovery being $1,874,809, an average of $7.75 a ton. In Kirkland Lake 35,212 tons was treated, the recovery being $459,353, an average of $13.05. This gives an average recovery of all the mines of $8.40 a ton. The total figures for the eleven months show that 3,060,576 tons was treated, the recovery being $27,209,970, an average of $8.90.

Better news is reported from the Tough-Oakes Burnside, in the Kirkland area. New ore has been found which greatly improves the future prospects of the mine. A reasonable profit will be made in December, and the company now appears to have definitely turned the corner, and instead of showing monthly deficits, as was the case in the early part of the year, will be able to show profits which will greatly strengthen the financial position.

There has also been a gradual improvement at the Barry-Hollinger mine, at Boston Creek. During June, July, and August the main supply of ore going to the mill came from surface dumps, and the recovery was only a little better than $5 a ton; in October the recovery was $9.70 and in November the average was $11.20 a ton. A cyanide addition is being made to the mill, which has a present capacity of sixty tons a day, and when this is installed the recovery will be substantially increased. Early in the year the shaft will be continued to 1,000 ft., as the ore on the 750 level is the best yet encountered.

The Gold Hill Mining Co. has financed further operations through the sale of the balance of the treasury stock to a Toronto brokerage house, the average price being 32c. a share. The money raised will be sufficient to develop a new 400 level and continue the shaft to 500 or 600 ft.

On the 275 level of the South Lorrain property of the Mining Corporation, a branch vein of the rich Watson oreshoot has been found. The work, which has only started, disclosed in places five inches of rich ore.

The Capitol Silver Mines, of Gowganda, has completed payments on all of the claims which it had under option and now owns outright a solid block of twenty claims, totaling 800 acres. At the present time the property is closed down, but work will be resumed

as soon as the new power transmission line into Gowganda is completed.

The Noranda mine, of Quebec, is opening up in a splendid way, and developments on the third level are more than bearing out the original expectations. The known bodies which have been intercepted confirm the values shown in the upper levels. One new orebody has been found and there are indications that another may be encountered soon. The new orebody assays approximately $20 a ton in gold and silver over a width of 20 ft. It is understood that negotiations will shortly be completed for the control of the Amulet property. The transaction involves supplying the necessary capital for development, on an option basis, the purchasers getting stock for the money advanced.

Research Council to Study Magnesite Deposits of Canada

The National Research Council of Canada has undertaken to assist the producers of magnesite to develop the industry and compete in the world market. A deposit stated to be the largest on the continent occurs in the Grenville district of Quebec between Ottawa and Montreal. It was worked during the war, but since then the market of the United States has been supplied from Austria, the sources of supply there being largely controlled by American users of magnesite. To enable Canadian magnesite producers to compete with the Austrian product the Research Council hopes to reduce the cost of production by rendering it possible to utilize a larger proportion of the crude rock and to effect improvements which will make the Canadian product superior to all others.

Barry-Hollinger Enlarges Mill

The Barry-Hollinger, in the Boston Creek gold district of northern Ontario, is installing new equipment, and an additional tube mill will be erected as soon as possible, increasing the crushing capacity to 100 tons per day. The management contemplates a change from the straight concentration system to that of cyaniding. In drifting on the 500 level what appeared to be an entirely new orebody of about 3 ft. in width was encountered, samples of which showed high gold content. Plans for sinking the shaft from 625 ft. to 1,000 ft. are completed.

Barnes-King Development Co. Dissolves

A decree of dissolution for the Barnes-King Development Co. was signed and filed in the district court at Butte, Mont., last week. The decree named as trustees and distributors the following: Charles W. Goodale, A. J. Davis, president of the First National Bank of Butte, T. A. Marlow, a banker of Helena; F. L. Melcher, president of the Western Iron Works, Butte; J. S. Cohen, of the Symons Store, Butte; R. C. Monahan, and John Corrette. The last named is a member of the legal staff of the Anaconda Copper Mining Co.

London Letter

By W. A. Doman

Special Correspondent

Proposed to Reorganize Camp Bird by Reducing Capital

Mexican Corporation, Ltd., Makes Profit of £6,223, as Compared with Loss in 1924

London, Dec. 15—A reorganization program of Camp Bird is now before the shareholders. It is proposed to reduce the present capital of £2,100,000 (divided into 750,000 7 per cent cumulative participating preference shares of £1 each and 1,350,000 ordinary shares of £1 each) to £1,109,579, of which there will be 1,100,051 ordinary shares of 2s. each. The proposal is to cancel paid up capital lost or unrepresented by available assets to the extent of 18s. It is intended to modify the rights of the 7 per cent cumulative participating preference shares, the rate to be raised to 8 per cent and the participating rights to be abrogated. With the modification of the participating and voting rights of the preference shares, the way will be open for a resumption of dividends on both ordinary and preference shares, especially as the developments at the Santa Gertrudis group of mines and at the Fresnillo mines, operated by the Mexican Corporation, are so highly satisfactory. The Santa Gertrudis and Mexican Corporation have got rid of the burdensome conditions of note issues, and the revenue accruing to Camp Bird as from March of next year is expected to enable that company to make handsome distributions in the event of the reorganization plan being carried through. It is seldom that a mining company reorganizing its capital on such lines is able to issue shares at a premium, but the new Camp Bird ordinary can be underwritten at 5s. per share, and these are to be offered to ordinary shareholders. The proceeds of 1,100,000 shares will be available for working capital, while the premium of 3s. per share, which will provide £150,000, will be applied to liquidate a part of the preference dividend arrears. The balance of £100,000 owing is to be satisfied by the issue of income certificates redeemable by equal annual payments over five years and carrying 7 per cent interest payable out of profits. These income certificates will rank for interest and redemption after the preference dividend has been paid and will hold preference over any distribution on the ordinary capital. There is every likelihood that the program will go through.

The annual report of the Mexican Corporation, Ltd., was rather disappointing, although a profit of £6,223 was made, in comparison with a loss of £3,974 for the twelve months to June 30, 1924. The Fresnillo unit treated 1,392,774 tons, or nearly 100,000 tons more, producing 8,317 oz. of gold and 5,661,880 oz. of silver, in comparison with 9,890 oz. of gold and 5,451,530 oz. of silver, though the total net profit was only $53,186 in contrast with $253,671. The ore reserves have risen from 6,518,971 tons to 7,066,599 tons, with a value of 0.17 dwt. of gold and 5.72 oz. of silver.

A. Spencer Cragoe, who has been touring Mexico, California, and Arizona for about eight months, has now returned and states that a large and increasing flow of American capital is going into the land and mines in Mexico.

The South American Copper Syndicate proposes to increase its capital from £100,000 to £150,000 by the creation of 500,000 shares of 2s. each. The company has borrowed £150,000 on notes. There have been many disappointing delays at the mines, and finance has had to be rearranged. Monthly returns are now improving, and so provide a better basis for negotiations with the note holders.

The Russo-Asiatic Consolidated has issued its report, and at the meeting to be held on Dec. 17, Leslie Urquhart promises to deal with the further negotiations for the return of the company's Russian properties which have been carried on so long, but so far without definite conclusion.

It is expected that the Villemagne Silver Lead Co., in France, will begin milling next month; meantime it is stated that developments continue satisfactory. The total expenditure on extra-Russian interests to Dec. 31, 1924—the report is late—amounts to £247,895. The company has investments in government securities standing in the balance sheet at £526,280.

A company called the Central Provinces Mining Co. (India) has been formed with a nominal capital of £500 in 1s. shares to deal in minerals and metals, principally manganese, bauxite, tin, copper, gold, and silver.

Nacozari Cons. Copper Co. Tests by Diamond Drilling

The Nacozari Consolidated Copper Co. of Douglas, Ariz., owning properties in the Nacozari mining district of Sonora, Mexico, signed a contract, Dec. 18, for 10,000 ft. of diamond drilling, to be carried out by James Valenzano, contractor, who has for the last three years been drilling in this district. This exploration work will start at once and will be conducted under the direction and supervision of Henry C. Beauchamp, of Douglas, Ariz., consulting engineer for the Nacozari Consolidated, and is the first of an extensive program for "proving up" the company's three main copper areas—Sinaloa, Beaumont, and Tharsis York. The first holes, from 500 to 1,000 ft., will be drilled at the Sinaloa, and will be started in commercial ore cropping at the surface.

Development Work at Valenzuela Mine

The Valenzuela mine, 25 miles east of Nacozari, Sonora, Mexico, was denounced by Holling and Antunez and recently titled. Development work is being carried on in a new shaft, which now has a depth of 60 ft. A 12-ft. vein which carries silver has been opened up. A carload of ore from this shaft gave a smelter return of 0.5 oz. of gold and 220 oz. of silver per ton. There are several large veins in this camp, all of which have had good values near the surface.

Societies, Addresses, and Reports

Progress in Industrial Standardization During 1925

Mining Industry Has Been Active for First Time, According to American Engineering Standards Committee —Distribution To Be Considered

THE last year has shown important developments in the growth of the industrial standardization movement, according to a report by C. E. Skinner, chairman of the American Engineering Standards Committee. One of the most important of these has been the increase of active interest on the part of industrial executives. A conference of first-line executives, held early in the year, organized a committee from their number to serve as an advisory committee to the American Engineering Standards Committee, and these men are now giving time and assistance to the solving of national standardization problems. Hitherto, the matter of standardization has been left largely to the technical man, but it is now generally recognized that standardization is a managerial problem of first importance.

Sixteen Mining Projects Under Development

The mining industry is the most recent of the great industries to take up standardization on a comprehensive scale. The leaders in the movement have been the U. S. Bureau of Mines and the American Mining Congress. In addition to the sixteen standardization projects now under way, under the procedure of the A.E.S.C., three more have been officially proposed. A notable step in the prevention of mine explosions has been the completion of a code for rock dusting of coal mines, through the co-operative effort of all interested groups. Catastrophes due to coal-mine explosions can be prevented by the simple expedient of spreading rock-dust thickly enough to cause an incipient coal-dust explosion to die out rather than to travel through mine atmosphere.

Of special interest to the factory owner and manager is the Directory of Specifications, published in August, 1925, by the Department of Commerce. This compilation lists approximately 27,000 existing specifications covering 6,000 commodities, and it will be found very useful in connection with purchases. The astonishing multiplicity of specifications on the same subject has brought sharply forward the problem of unifying them into consistent groups. Such unification is an industrial and economic problem of moment.

The list of projects now before the A. E. S. C., at various stages of development, totals 218, including seventy-six approved standards. Notable progress has been made during 1925 in the completion or further development of many of these projects. The number of projects of each industry represented in this work, through 250 national organizations, is as follows: Civil engineering and the building trades, 35; mechanical engineering, 63; electrical engineering, 32; automotive (automobile and aircraft), 4; transportation, 9; shipbuilding, 1; ferrous metallurgy, 9; non-ferrous metallurgy, 15; chemical industry, 12; textile industry, 3; mining, 16; wood industry, 5; pulp and paper industry, 1; miscellaneous, 13.

In the field of mechanical engineering, a system of limited gaging, together with a comprehensive scheme of fits, which is probably the most important project ever carried through by the American Engineering Standards Committee, lays the basis for the carrying out of complete interchangeable manufacture on a national scale, as well as for facilitating mass production within the individual factory. When this work permeates the structure of American manufacturing industry, the resulting savings will run into enormous figures. Two important dimensional standards, dealing with cold-finished shafting, and square and flat shafting keys, have also been approved recently.

At a conference in December a comprehensive program for the standardization of drafting room practice was launched. There has been great interest in this subject, and it bids fair to become a matter of first importance on account of the wide range of industries which it affects. Although many individual factories have already worked on the standardization of drafting-room practice, the United States has been, on the whole, far behind European countries in bringing about the economies which are possible through national standards.

Much Progress in Electrical Industry

In the electrical field, the 1925 edition of the National Electrical Code, the "bible" of the electrical wiring industry, has been approved. Also, a system of connections and markings for electric power apparatus, representing the combined effort of a large number of engineers, has been approved as American Standard, after standing the test of several years practical application on a large scale. A standard for instrument transformers has been recommended for approval, and a standard for synchronous converters has also been submitted.

For the first time complete national agreement has been reached on a safety code for aeronautics, in the development of which the military and civil branches of the Federal Government and the commercial and public agencies interested in the subject were represented.

In the field of industrial safety, satisfactory progress has been made on a program of about forty codes, most of which are applicable to factories. Seventeen of these have been completed, and work on half of the remainder is well advanced. Codes for paper and pulp mills, and elevators and escalators, were completed and approved during the year.

The fourth year of the work of Mr. Hoover's Division of Simplified Practice has shown even more rapid development than heretofore. In all, thirty-nine simplifications have already been carried through, ten others are in the final stages, and sixty-five additional surveys are now under way. More than 200 industrial groups are co-operating in the various projects.

Approximately 350 specifications have been promulgated by the Federal Specifications Board, which means that these specifications have been unified as between the various branches of the government. A leading part in this work is being taken by the Bureau of Standards, the Director of the Bureau being ex-officio chairman of the board.

International Co-operation Planned

Standardization on an international scale is still in its infancy; yet through the co-operation of the various national standardizing bodies there has been real accomplishment in several subjects. Of special interest, on account of its relation to the use of specifications in the development of foreign trade, is the First Pan American Conference on the Uniformity of Specifications, which was held in the first part of January, 1925, in Lima, Peru. It was decided to hold another such conference in the United States within a year or two.

In connection with the meeting of the International Electrotechnical Commission which is to be held in New York in April, 1926, there will also be held in New York a conference of the chairman and secretaries of the national standardizing bodies, for which the American Engineering Standards Committee will act as host.

Movement Well Organized

With some important exceptions, manufacturers generally have carried on their standardization work as a more or less incidental part of their engineering and production activities. But thorough-going standardization simplifies and clarifies every step in the work of the manufacturer from the solicitation of the order to the mailing of the receipted bill. Definite organization for standardization work within companies has thus become a pressing managerial problem.

Another special problem on which marked progress should be made during the coming year is to get organizations of distributors to play their proper rôle in the standardization movement. It is generally recognized that the most important industrial and economic wastes are in the field of distribution, and that broad programs of standardization are essential to the elimination of this waste. Mr. Hoover, for example, rates standardization as second only to statistics in its importance in the whole distribution problem.

Clapp Explains Montana Earthquake

At the meeting of the Montana Society of Engineers, held in Butte on Dec. 15, C. H. Clapp, president of Montana University, gave a brief talk on the geology of Montana. In his opinion, at two different periods the Arctic Ocean and Gulf of Mexico covered what is now Montana. On the first occasion the two bodies of water did not meet, but they mingled on the second occasion. These happenings occurred many million years ago. He further stated that the Butte fault which crosses the Missouri River to the north of Helena and is broken up to the south was formed in a period when the area was covered by a great many lakes, the accumulating erosion deposits in the lakes causing a shifting of balance and condition of strain.

According to Dr. Clapp's theory it was this faulting, caused by an overthrust from the west or an underthrust from the east, that was the cause of the earthquake last June. Settling or slipping at a point about ten miles north of Three Forks was responsible for the shock. He stated that the Santa Barbara earquake was only one-tenth as severe as that in Montana, which was felt over 300,000 square miles.

M. I. T. Plans Phantom Radio Dinner for Jan. 19

The Massachusetts Institute of Technology Alumni Association on Jan. 19, 1926, will hold its second national all technology phantom radio dinner, at the Waldorf Astoria, New York City. Addresses will be broadcast from the following stations: Boston, WBZ (special); Springfield, WBZ; Schenectady, WGY; New York, WJZ; Washington, WRC; Pittsburgh, KDKA; Chicago; Hastings, Neb., KFKX; Denver, KOA; and Oakland, KGO.

The program will start at 9:30 p.m. New York time, with James J. Harboard, chairman of the Radio Corporation of America, as master of ceremonies. Among the speakers will be Vice-president Dawes, Herbert Hoover, who will speak from Washington, and Dr. S. W. Stratton, president of M.I.T., who will speak from Boston.

American Road Builders' Association Meets at Chicago

The largest exhibition of road-building machinery, equipment, and supplies ever gathered together—totaling 300 carloads—is expected at the Road Show and Convention of the American Road Builders' Association to be held in Chicago from Jan. 11 to 15, 1926. In addition to the presence of the foremost highway engineers, executives, contractors, and machinery manufacturers, delegates are being sent by the Latin-American countries. They are coming to observe the latest road-building methods and machinery, so as to insure the use of proper and economical methods of highway construction in those republics. The development of the country is helped by highways.

Engineering Educational Leaders Gather at Brooklyn

More than 150 presidents of American colleges and universities and representatives of engineering and learned societies will gather in Brooklyn, N. Y. on Jan. 13, 1926, to attend the inauguration of Dr. Parke Rexford Kelbe as the new president of the Brooklyn Polytechnic Institute. The National engineering societies will be represented by W. S. Kinnear, president of the American Institute of Consulting Engineers; Dr. Michael I. Pupin for the American Institute of Electrical Engineers; H. Foster Bain, secretary of the American Institute of Mining and Metallurgical Engineers, and Robert Ridgway, for the American Society of Civil Engineers.

Cottrell Awarded Medal

The Mining and Metallurgical Society of America awarded its gold medal for the year 1924 to Dr. Frederick Gardner Cottrell for "distinguished service in the development of a method of electrical precipitation of solid and liquid particles from smelter smoke, and in recognition of his public spirit in making a gift of the proceeds of his invention for the support of scientific research."

Complying with Dr. Cottrell's wishes, dictated by his extreme modesty, the medal was presented informally at a luncheon held in his honor at the Cosmos Club, Washington, D. C., on Dec. 7. There was present a group of his former associates in the government service, including D. A. Lyon, G. S. Rice, O. P. Hood, A. C. Spencer, W. C. Mendenhall, David White, Samuel Sanford, C. E. Julihn, George Otis Smith, C. E. Monroe, and P. G. Nutting.

The committee of award was C. A. Meissner, chairman; Arthur L. Walker, and E. P. Mathewson.

Arizona Safety Engineers Meet

Under the auspices of the Arizona chapter of the American Mining Congress, ten safety engineers, representing the larger mining companies of the state, met on Oct. 29 and 30 at the Adams Hotel, in Phoenix, Ariz., to discuss safety problems. Two papers were read—one by A. S. Bilderbach, of the United Verde Copper Co., covering the safety work among the Mexican employees at that mine, and the otner by Thomas Cowperthwaite on the establishment of safety organizations.

A number of safety problems were discussed, including blasting accidents, foot and toe accidents, smelting accidents, haulage accidents, the handling of explosives, goggles, and the use of pinch bars. A resolution was passed advocating the establishment of an Arizona Chapter Safety Section. The advantages of such a section were indicated as follows: 1, Uniform system of safety training throughout the state; 2, standardization of practical and general safety problems; 3, a system by which trained men could be recognized throughout the state by the employment departments; 4, reduced expense by eliminating duplication of experiment costs.

Platform for Engineering Foundation

The following platform for Engineering Foundation was adopted at a meeting of its board on Dec. 10, after approval of a draft by the governing body of each Founder Society, based on a unanimous recommendation of their joint conference committee:

"Desiring to promote active and wisely directed research as a means to scientific and technical progress, and believing that systematic co-operation by Engineering Foundation and the several Founder Societies is essential to any development of the research work of the societies commensurate with the dignity, influence, and resources of the profession, Engineering Foundation, while reserving entire liberty of action under the authority conferred upon it by the Founder Societies, through United Engineering Society, adopts the following declaration of its present plan and policy:

"1. Engineering Foundation regards engineering research as the preferred field for its activities.

"2. It will select or approve specific researches which it will assist by appropriation of funds or otherwise.

"3. It will select for each project the agency, collective or individual, which it deems most effective.

"4. It will assume no direct responsibility for the prosecution of any specific research.

"5. It will co-operate with the national engineering societies and preferably support researches approved by it sponsored by one or more of them.

"6. A member of Engineering Foundation, or of its staff, may be an advisory, but not an active, member of any committee or other organization in immediate charge of a research assisted financially by the Foundation. This provision will not be retroactive.

"7. Engineering Foundation reserves the right to require from committees or other organizations or individuals assisted, satisfactory progress reports as a condition of continued support.

"8. Engineering Foundation will co-operate with the several founder or other national engineering societies in raising funds for the prosecution of approved researches.

"9. It will endeavor to prevent conflict or overlap of research effort among the agencies which it supports or assists.

"10. It will co-operate in securing information of the state of the art for use of committees of the Founder Societies or other agencies."

Adoption of this plan, it is hoped, will place the impartial and judicial attitude of Engineering Foundation beyond the questions which, without it, would have arisen in the future.

Addresses Russian Engineers

Ernest R. Lilley, professor of geology at New York University and the author of the recently issued book on "The Oil Industry," spoke before the Russian Association of Engineers on "Recent Technical Advances in Cracking and Refining and Their Effect Upon the Petroleum Oil Reserves," in New York on Dec. 29.

Recent Technical Publications

Reviews, Abstracts, and References

Plastic Magnesia—The magnesite industry of the Pacific Coast is a by-product of the World War; at that time, Austrian imports were shut off and domestic deposits were opened which have since competed with the foreign article. An important use for magnesite is as a raw material for making the so-called Sorel cement composition flooring, stucco, and plasters. As mined, the pure product contains about 52 per cent carbon dioxide. A good commercial grade of plastic magnesia contains as much as 4 or 5 per cent. Dead-burning gives a product unsuitable for making magnesian cements but adapted to refractory purposes. A bulletin on "Plastic Magnesia," by Oliver C. Ralston, Robert D. Pike, and Lionel H. Duschak, recently issued by the U. S. Bureau of Mines, contains a great deal of information of interest both to producers and consumers, and may be obtained for 30c. from the Superintendent of Documents, Washington, D. C.

Rhodesia—The *Mining and Industrial Magazine of Southern Africa* for Nov. 18 (Johannesburg; price 6d.) is a special Rhodesian number and contains many short articles descriptive of operations in that district.

Butte—Bulletin 257 of the U. S. Bureau of Mines is a "Review of Safety and Health Conditions in the Mines at Butte," by G. S. Rice and R. R. Sayers. Mining conditions in this district are possibly the most difficult of any in the country, with high rock temperatures, heavy ground, and siliceous rock dust, but great advances have been made in the solution of the problems in the last ten years. Copies of the 29-page report are obtainable for 10c. from the Superintendent of Documents, Washington, D. C.

Clay—"Georgia and Alabama Clays as Fillers" are discussed by W. M. Weigel in Technical Paper 343 of the U. S. Bureau of Mines, 34 pages. Clays for use as fillers must be white, or nearly so; they are used in the manufacture of paper, wall paper, rubber, paint, oilcloth, textiles, kalsomine, plaster, and matches. The various requirements to be met are stated in this bulletin, which may be obtained for 10c. from the Superintendent of Documents, Washington, D. C.

Crude Oil—Technical Paper 346 of the U. S. Bureau of Mines, 43 pages, is entitled "Properties of Typical Crude Oils from the Producing Fields of the Western Hemisphere." It is by A. J. Kraemer and L. P. Calkin. This is the first publication of the Bureau to deal with the properties of foreign oils. Copies are obtainable for 5c. from the Superintendent of Documents, Washington, D. C.

Shaft Design—A. L. Egan has a nine-page paper on "The Design of Tips for Vertical Shafts" in *The Journal of the South African Institution of Engineers* for November (Johannesburg; price 2s.). The discussion is of a theoretical nature.

Mint Report—The annual report of the Director of the Mint for the fiscal year ended June 30, 1925, 241 pages, has been issued, and may be obtained on request from the Director of the Mint, Treasury Department, Washington, D. C. As usual, a report on the production of precious metals during the year is included, the whole making a highly valuable and interesting reference book on the gold and silver industry of the United States and the world.

Copper in the Philippines—*The Far Eastern Review* for September (16 Jinkee Road, Shanghai, China; price, 50c.) contains a short article descriptive of the history of copper mining in the Philippines, with brief references to the known deposits of the islands.

Siberian Gold—The magazine mentioned in the preceding paragraph also has a three-page article by G. T. Eve on "The Selemdja Alluvial Gold Deposits," of Amur Province, Eastern Siberia. Their history and present possibilities are briefly related.

Subaqueous Prospecting—*The Canadian Mining Journal* for Dec. 11 (Gardenvale, Que.; price, 15c.) contains a three-page article by E. M. Kindle on "Propecting Under Water." The author shows how samples are taken from the bottoms of lakes or streams.

Rotary Drilling—"Mechanical Safeguards in Rotary Drilling" is the title of U. S. Bureau of Mines Technical Paper 369, 38 pages, by H. C. Miller. It is obtainable for 10c. from the Superintendent of Documents, Washington, D. C.

Selective Flotation—One of the most up-to-date large mills for the treatment of lead-zinc ores is that being built by the U. S. Smelting, Refining & Mining Co., at Midvale, Utah. It is described by C. A. Lemke in the December issue of *The Mining Congress Journal* (Washington, D. C.; price, 30c.). The mill is of 500 tons' capacity, and is equipped with gyratory crushers, rolls, rod mills, and M. S. flotation machines.

Rubber Ball-mill Linings—The magazine mentioned in the preceding paragraph also contains a three-page article on "Rubber Linings for Wet Grinding Ball Mills," by B. W. Rogers. Mr. Rogers is connected with the B. F. Goodrich Rubber Co., and discusses the test work that has been carried out on this type of liner, and the advantages that are expected to be gained.

Arizona—"Gold and Copper Deposits Near Payson, Arizona," are discussed by Carl Lausen and E. D. Wilson in a 44-page bulletin recently issued by the Arizona Bureau of Mines. The district is north of Roosevelt Dam, and about midway between Globe and Jerome. Some promising mineral deposits occur there, one now being worked by the Atlantis Mining Co., but lack of cheap transportation hinders their development. Copies of the bulletin, which is No. 129, may be obtained on request from the Arizona Bureau of Mines, Tucson, Ariz.

Treating Gold-Copper Ores—"The Treatment of Gold-Copper Sulphide Ores" is discussed by B. Du Faur in the Sept. 5 issue of *Chemical Engineering and Mining Review* (Melbourne; price 9d.; or British & Colonial Press, Inc., 163 E. Erie St., Chicago, Ill.). Mr. Du Faur shows details of a flotation machine designed by him and discusses a patented process for the continuous production of ferric sulphate.

Laboratory Electric Furnace—In the publication just mentioned is also a short article by A. T. Fry on "An Electric Resistance Furnace for Laboratory Roasting." Arcing trouble often occurs when graphite electrodes are used to supply current to a carbon resistor. To avoid this, the electrodes were separated from the coke mass to keep them cool, and contact effected by channels sloping downward to the electrodes, filled with broken graphite to provide a path whose resistance was low and hence which would avoid heat at the electrode surface.

Gold Coast—Bulletin No. 1 of the Gold Coast Geological Survey is, appropriately, "Outlines of the Mineral and Water-power Resources of the Gold Coast, British West Africa, with Hints on Prospecting." It is a 56-page bulletin, including a map, and is by A. E. Kitson. The three main mineral industries of the country are gold, manganese ore, and diamonds, though an undeveloped resource in the shape of large deposits of high-grade bauxite exists. Copies of the bulletin are obtainable for 1s. from the Director of the Geological Survey of the Gold Coast, 29 Alfred Place, South Kensington, London, S.W. 7, England.

"Notes on Diamond Prospecting, Gold Coast Colony," is the subject of a paper by A. Livingstone Oke in the December *Bulletin* of the Institution of Mining and Metallurgy. The paper includes a description of the field methods employed and illustrates the rockers and jigs employed. The paper discusses the actual prospecting methods rather than the geology. Copies are obtainable for 1s. each from the Offices of the Institution, Cleveland House, 225 City Road, London, E.C. 1, England.

Air Compressor—"A New Form of Air Compressor" is described in a 20-page paper by Dr. H. S. Hele-Shaw in the December issue of the *Bulletin* of the Institution of Mining and Metallurgical Engineers. The design is quite radical, being a compressor of the rotary type, chiefly interesting to the mining world in its larger sizes, though small machines operate efficiently and may find a place, as turbo-compressors do not appear to be economical below a delivery of about 2,000 cu.ft. of air per minute. The chief problems in the design of the new compressor were those of lubrication and sealing, and they seem to have been happily solved. Copies of the paper may be obtained for 1s. 6d. each from the address given in the preceding paragraph.

Zinc Metallurgy—The November issue of the bulletin just mentioned also contains 26 pages of discussion of Gilbert Rigg's paper on the metallurgy of zinc, referred to on page 750 of our Nov. 7 issue.

Men You Should Know About

Ralph C. Maxwell, metallurgist for the Peñoles company, is in New York from Torreon.

W. A. Clark, Jr., recently was in Butte to inspect the operations of the Clark estate holdings.

John G. Kirchen, general manager for the Tonopah Extension Mining Co. at Tonopah, Nev., has been in New York on company business.

J. E. Spurr attended the joint meeting of the Geological Society of America and the Society of Economic Geologists held in New Haven, Conn., in the week beginning Dec. 28.

Henry Louis, of Newcastle-on-Tyne, England, sailed from New York on Dec. 28, 1925, for his home. Professor Louis had just returned to New York from an examination trip in Mexico.

L. R. Robins, superintendent for the Tonopah Belmont Development Co. at Tonopah, Nev., has returned to Tonopah from a visit to newly acquired property by his company in Arizona.

Colonel W. B. Thompson has cancelled his plan to visit copper mining developments in Africa because of illness which will compel him to return to New York early in January.

Charles S. Smith, president of the Old Dominion and Arizona Commercial mining companies, has been in the Globe district of Arizona inspecting the properties of the two companies.

Paul T. Bruhl has returned to Honduras from a vacation to New York, and has resumed his duties at Rosario as mill superintendent of the New York and Honduras Rosario Mining Co.

C. R. Wilfley, mining engineer of Ouray, Colo., has been appointed consulting engineer to the Ophir Bondholders' Committee, of Milwaukee, operating the Silver Bell mine, at Ophir, Colo.

S. R. Guggenheim has left New York to spend several weeks on his houseboat "Trillora" at St. Augustine, Fla. **Murry Guggenheim** is en route to St. Augustine for several weeks' holiday on his houseboat "Leonie."

D. C. Byer, assistant manager of the Fairbanks Exploration Co., recently spoke before the milling and mining short course students of the Alaska School of Mines on the subject of "Prospecting Placer Ground."

H. L. Batten, an engineer who is reported to represent large British mining interests, recently examined and sampled the Victory and Mamie groups of gold-silver-lead-zinc claims on Hudson Bay Mountain, Smithers, B. C.

Prof. James M. Hyde, professor of metallurgy at Stanford University, who has announced his candidacy for the United States Senate, made the first speech of his campaign in Los Angeles recently at the monthly meeting of the City Federation of the W.C.T.U.

Dr. J. P. Schumacher, of Holland, formerly with the Royal Dutch Shell Company, has established offices in Houston, Tex. He will conduct a consulting business in the operation of torsion balances to locate hidden salt domes in the Gulf Costal region of Texas and Louisiana.

Judson C. Welliver, a former Washington newspaper correspondent, who had been chief clerk at the White House since the beginning of President Harding's administration, resigned recently to become publicity director for the American Petroleum Institute.

S. J. Swainson, of Salt Lake City, Utah, recently joined the engineering and metallurgical staff of the Simpson Engineering Co. of Long Beach, Calif., and will be in charge of the flotation testing department. Mr. Swainson is

S. J. Swainson

a graduate of the University of North Dakota, and held a fellowship at the University of Utah. Since completing his collegiate work, he has been engaged in research in flotation at the University of Utah, in co-operation with the U. S. Bureau of Mines.

Emmet D. Boyle, former Governor of Nevada, now manager for the Mason Valley Mines Co., near Yerington, Nev., was prostrated by a heart attack on Dec. 9 while on a mine examination near Happy Camp, Calif. He has been removed to Reno, and while his condition is improving he is still under hospital attention.

M. H. Sullivan, superintendent of the Bunker Hill & Sullivan company at Kellogg, was elected chairman of the Columbia section of the American Institute of Mining and Metallurgical Engineers, at the annual election and social session held at Spokane recently. **Frederick Keffer** was chosen vice-president and **L. K. Armstrong** was re-elected secretary.

Obituary

Ben. D. Luce, who was one of the successful pioneer operators on tailings ponds in the Tonopah district, died early in December, 1925, at his home in Inglewood, Calif.

Frank J. Kipp, sixty-eight years of age, capitalist and retired banker, died in Milwaukee on Dec. 18, 1925. Mr. Kipp's greatest interest was in mining. He owned a large block of stock in the Hecla Mining Company.

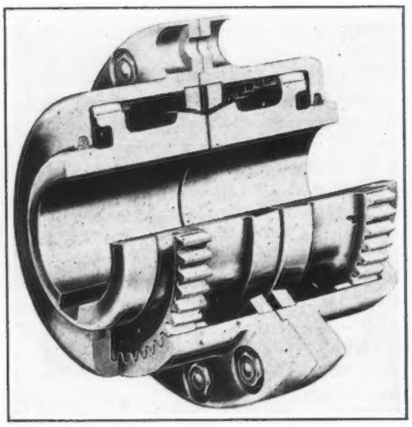
Bert Edward Duggan, for many years representative of the Denver Rock Drill Manufacturing Co. for Arizona, with headquarters in Phoenix, died at his residence in that city on Dec. 16. He is survived by a wife and three daughters.

John George Devlin, a well-known mining man, died recently at Alice Arm, B. C. He was engaged in mining in British Columbia for many years in the early days of the Rossland camp, where he made considerable money. Six years ago Mr. Devlin came east to Manitoba and operated in the Rice Lake district. He is survived by two sons and two daughters.

Lieutenant J. K. Romig, Jr. (Officers' Reserve, U. S. A.) was instantly killed in an auto accident on "The Old Oregon Trail" near Hot Lake, Oregon, on Oct. 19, 1925. He was twenty-eight years old. In April, 1917, he enlisted and was assigned to Company A, Sixth Field Battalion Signal Corps, Regular Army; he was commissioned Second Lieutenant, Infantry, August, 1918, and Lieutenant, Officers Reserve Corps, Army of the United States, October, 1919. Lieutenant Romig was born at La Grande, Ore., where he was buried, with military honors, Oct. 22, 1925. Since his discharge from the army, in October, 1919, Lieutenant Romig had followed the work of a civil and mining engineer and was the owner in large part of the Sanger group of gold mines, operation of which it was planned to start at an early date.

Captain Harry C. Wheeler, former sheriff of Cochise County, and noted Peace Officer, who organized the vigilance committee to rid the Bisbee district of Industrial Workers of the World, who were hindering the production of copper during the war, and handled the deportation of undesirables from that camp on July 12, 1917, died at Warren, Ariz., on Dec. 16. Captain Wheeler was fifty years old. His father, Colonel William B. Wheeler, saw service in both the Civil and Spanish-American wars. Wheeler was a member of the first United States regulars from Oklahoma, in the latter war. He located in Tombstone in 1900, and enlisted as a private in the Arizona Rangers, and before the disbandment was a captain. Wheeler seldom failed to get his man, even though it took him into the wild and then almost unexplored mountain fastnesses of Cochise and Pima counties. When the rangers were disbanded in 1909 Wheeler was prevailed upon to run for sheriff. He was first elected in 1912 and was chosen for two more succeeding terms. Before the completion of his third term he resigned to join the army, and a few months later sailed for France as captain in a cavalry unit. In the past few years Captain Wheeler had been operating a lease on Copper Queen ground, with the exception of a few months he spent on a ranch he purchased in 1920. Captain Wheeler was a member of the Douglas Post of the American Legion, and was given a military funeral from the family home in Warren, Ariz., both the Bisbee and Douglas posts participating. He leaves a widow and two small children.

New Machinery and Inventions



Section through assembled flexible coupling

Flexible Coupling Easy to Align

A new flexible coupling is shown in the two illustrations accompanying. It consists of six parts, two hubs having an external gear on each, meshing with internal gears in two sleeves which are bolted together, and two aligning rings which are fitted in the two sleeves.

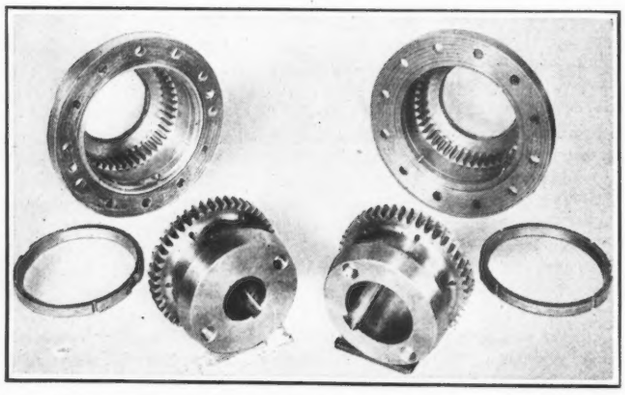
The outer faces of the teeth on the hubs are formed spherically, which provides a true self-aligning bearing for the connecting sleeve, so that if the two shafts are out of alignment the sleeve assumes a neutral position with a perfectly formed and lubricated bearing on the spherical surface of each shaft hub.

The principal features are: An all metal gear type of coupling, lubricated and self-aligning without binding action at any point; simplicity of design, requiring few parts, which are easy to install—no springs, bushings, pins, laminations, or other wearing parts to give trouble or require replacement; unusual strength, greater in all cases than the connected shafts; and complete protection from dust and dirt.

It is easy to line up when the coupling and the connecting shafts are being assembled. Each hub of the coupling has a tapered surface which in turn engages with a tapered surface on the interior of each sleeve. When the sleeve is pushed back then the sleeve, hub and shaft act as a single unit and proper alignment can be quickly and accurately made by using a straightedge across the two flanges of the sleeves and calipers or feeler gages between the coupling faces. The sleeves and hub are never out of tooth engagement during alignment.

All parts are made of high-carbon forged steel. Oil holes are provided in one side of the coupling flange where oil should be poured in until it runs around the shaft hub.

The coupling operates equally well in either direction, on continuous or reversing service and at high or low speeds. It is made by the Poole Engineering & Machine Co., Baltimore, Md.



Flexible coupling disassembled into its component six parts

Oil Burner and Preheater Useful for Shop Work

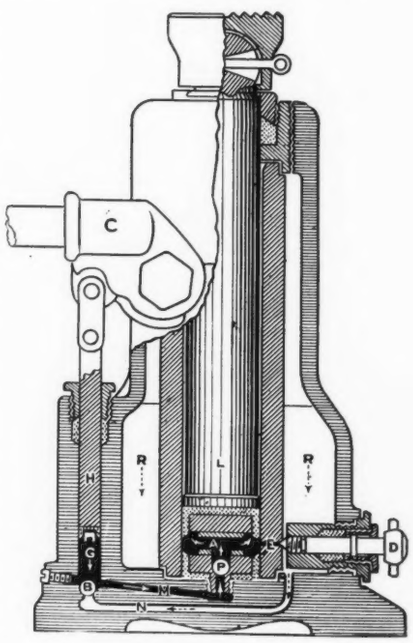
Operations that can be performed economically and advantageously with an oil burner and preheater are numerous and varied. In foundries, boiler shops, machine, and repair shops the uses range from heating soldering irons to burners for core ovens, annealing furnaces, and the like. The Milburn oil burner and preheater, made by the Alexander Milburn Co., Baltimore, Md., is designed to give maximum combustion and greatest heat in the quickest time. It is of the atomizing type, utilizing economically the cheapest grade of crude, fuel, kerosene oil, or distillate and compressed air under pressure varying from 50 to 100 lb. The air supply line serves two purposes. While furnishing a direct flow to the burner, the air also maintains a similar pressure in the oil-storage tank, creating a greater velocity in the oil feed line, and thus insuring a positive and uniform flow of both oil and air.

The burner embodies the latest scientific developments. The flow of both air and oil are through straight-line orifices, unhindered by coils or staggered passages. The oil, under pressure, enters the atomizing chamber at right angles to it and in an annular form, while the compressed air flows directly through the center, striking the filament of oil and completely atomizing it, then expanding it in a venturi-shaped outlet. Consider the thorough mixing vortex that is set up, producing an intimate and perfect mixture of both oil and air, which insures complete consumption and maximum heating value at the flame. No particles of fuel are blown through the flame unconsumed. There is no siphoning effect of either oil or air. Immediately upon opening the valves the gas at the burner can be ignited. Carbonization and oxidation are absolutely eliminated.

A New 10-ton Jack

Smooth and quick operation are advantages claimed for the jack here shown. It is said to raise its load with little effort, and to lower it without jar or shock. It is now available only in the 10-ton size. Later, 6-, 3- and 1-ton jacks will be put in production. The jack may be operated with inch-by-inch motions of the handle, if desired, and may be stopped instantly at any position. It is adapted for use in cramped quarters; in dangerous places it may be operated at a distance by using a long handle. The construction and operation of the jack may be noted from the accompanying illustrations on this and the opposite page.

Raising the handle of the jack, which fits into socket *C*, raises pump plunger *H*, drawing oil from reservoir *R* through channel *N* and ball check valve *B* into chamber *G*. Lowering handle compresses oil in chamber *G*, seating valve *B* and forcing oil through channel *M* past ball check valve *P* into chamber *A*, causing plunger *L* to raise



Construction of the oil jack. Letters refer to the text

and lift the load. To lower the load, the needle valve *D* is turned slightly, which serves to open outlet *E* and permits oil to travel back into reservoir *R*. Motion of the handle controls the lifting of the load at any point of stroke either up or down, and the load positively holds its position. The needle valve *D* controls speed of lowering; closing needle valve holds load at any point.

Oil is not under pressure in reservoir *R*, which is in the main casting, the pressure occurring in chamber *A*, which is surrounded by a steel jacket. Long service has been a primary consideration in the design. The swivel head is corrugated and hardened to assure firm grip under load. The ram is of steel, is 1⅜-in. diameter, and is heat-treated and ground. Adjustable oil-retaining packings are provided to prevent leak-

Oil jack

age. The rocker arm has a positive stop, oscillates on a heat-treated fulcrum bolt, and projects over the pump stem and thus protects it. The base of the new jack is 6½ in. in diameter.

The device is known as the Pedersen "oiljak" and is being handled by the Oil Jack Co., Inc., 1457 Broadway, New York.

Centrifugal Compressor Used With Oil-Burning Furnace

The Champion Porcelain Co., of Detroit, whose andalusite mine in California was recently described in the *Mining Journal-Press*, has installed a new design of centrifugal compressor for supplying air to oil-burning furnaces. This compressor, built by the General Electric Co., delivers 1,800 cu.ft. of air per minute to the furnaces at a pressure of 1½ lb. per sq.in. gage and operates at a speed of 3,450 r.p.m., directly connected to a 20-hp., 3-phase, 60-cycle, 220-volt, 3,600-r.p.m. induction motor.

The motor is controlled by a General Electric hand compensator which brings the compressor quickly up to speed, keeping the time and current required for starting at a very low value as a result of the small inertia and specially designed oil pressure lubricating system of the compressor.

One of the features of the installation is that the operator can tell at a glance the volume of air being delivered to the oil furnaces and the corresponding current input, by means of a special, calibrated scale on the ammeter. This scale is calibrated in amperes and volume (cubic feet of air per minute).

By means of this plan the company can determine the operating cost of this part of its plant very accurately. From an operating standpoint, it enables the user to set any desired volume of air to the furnace simply by adjusting the blast gate, which is a valve in the air line. Regulating the opening of the blast gate will vary the volume of air delivered by the compressor. Thus, all the operator has to do is to adjust the blast gate until the desired volume of air is indicated on the meter.

Valve Made of Forged Steel for High Pressure Work

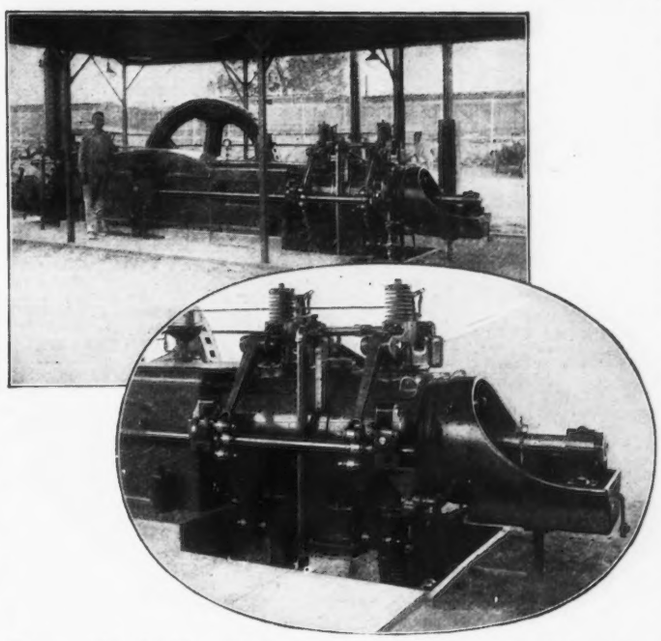
A new valve, known as the "Forgsteel" valve, has been introduced by the Hydraulic Press Manufacturing Co., Mount Gilead, Ohio, for high-temperature and high-pressure work. It is of a straightway type and is made of forged steel. This permits of a valve body of uniform section throughout, doing away with unequal expansion or contraction. Full opening is provided for the steam flow, the path of which is confined to as few angles as is possible with a valve made from a steel forging.

Tail-Rod Construction Adopted for Small Gas-Engine Compressors

Tail-rod construction for its small four-cycle double-acting gas-engine compressors has been developed by the Worthington Pump & Machinery Corporation, of New York. This serves the purpose of relieving the weight of the piston on the cylinder bore and also allows greater and more effective circulation of the cooling water through the piston and rod.

The box-type frame is heavily ribbed, has full-length bearing on the foundation, and is carried above the center line of power stresses to eliminate weaving. Special Diesel iron is used for the power cylinders. These are made separate and bolted to the end of the main frame. Expansion between inner and outer cylinder walls is taken care of by an expansion ring. All water passages are large and free from complications.

Inlet and exhaust valves are located at the top and bottom of the power cylinder, thereby equalizing stresses under temperature changes. The front and rear cylinder heads are symmetrical in shape and provided with large water-cooling spaces. This construction eliminates complicated castings and insufficient water-cooling space incident to construction where valves are located in the cylinder heads. The cylinder design also allows easy inspection and adjustment.



Four-cycle, double-acting, gas-engine compressor with tail rod

The power piston and rod are water-cooled, the circulating water entering the piston rod through the crosshead and after circulating through the piston leaves through the tail rod. Connecting rods, shafts, crossheads, etc., are of forged furnace-annealed steel.

A cast-iron housing with hand-hole plates between main frame and compressor cylinder prevents possibility of gas entering the crank case. A belt-driven Massey governor is mounted on the side of the main frame.

Trade Catalogs

Insulating Materials — The Mitchell-Rand Manufacturing Co., 18 Vesey St., New York, has just prepared a novel wall sheet of the tables most frequently used in both electrical and machine shops. Tables of inch equivalents, copper wire and similar data, have been separately printed in many forms for shop reference, but a single chart containing all of the tables in general use is thought unique by the company.

Through the co-operation of the Cleveland Twist Drill Co. a table on tap drill sizes was compiled. This table covers taps in common use between sizes 0-80 and 1-14 in. inclusive, gives size of drills recommended by the National Screw Thread Commission, and also "nearest other drills," in each case specifying the "per cent full thread of nut."

The U. S. Bureau of Standards supplied data for the copper-wire card and allowable carrying capacities for copper wire. The dimensions of twist drills and machine screws and other shop helps have heretofore been available only after search through technical publications.

Blasting — An illustrated booklet of 80 pages, entitled "Blasting Accessories," has been issued by E. I. du Pont de Nemours & Co., of Wilmington, Del. It gives complete and detailed data on the various accessories needed for firing charges of explosives, together with explanations of the best methods of using these accessories. Users of explosives may get a copy by addressing the Advertising Department of E. I. du Pont de Nemours & Co., Inc., Wilmington, Del.

Grinding Mill—Bulletin 1025 of the Williamson Co., San Francisco, Calif., 15 pages, describes the Williamson mill, which is said to use a smaller ball load than is usual, and hence less power, and to accomplish just as much. Fundamentally, it is claimed, there is a very thorough mixing of balls and charge.

Air-Washers—"Sirocco" air washers are featured in Bulletin 1923, dated November, 1925, of the American Blower Co., Detroit, Mich. The bulletin is of 32 pages and is illustrated.

Meters—Bulletin No. 70 of the Sangamo Electric Co., Springfield, Ill., describes Sangamo Type H single and polyphase watthour meters. It has 24 pages, illustrated.

Centrifugal Compressors — Single-stage centrifugal air compressors are covered in Bulletin GEA-233, issued by the General Electric Co.

The Market Report

Metal Markets Quiet But Firm

Holiday Dullness Was Expected—Lead the Only Metal in Much Demand

New York, Dec. 30, 1925—Copper, zinc, and tin sold in exceedingly limited amounts in the week ending today, as was anticipated, and business is not expected to amount to anything until next Monday. The Saturday immediately following Christmas was virtually a holiday, many offices being closed, so that quotations on that day are largely nominal. Lead has sold in close to normal amounts all week, and is distinctly the strongest of the important metals. Antimony continues to go into new high ground.

Metal sellers look back on the year just closing with general satisfaction. Of eleven important non-ferrous metals, nine are now selling at higher prices than a year ago, copper and lead being the only ones to have slipped a little, copper having been quoted at 14.65c., f.o.b. refinery, on Dec. 31, 1924, and New York lead having sold at 9.70c. at that time. Bismuth is selling for almost thrice what it did a year ago, zinc is almost a cent higher, and tin, nickel, antimony, silver, and quicksilver have registered modest improvements in price. There is not quite so much optimism for further price increases as there was at this time last year, though a continued excellent demand is almost assured for at least the first half of the new year. Many producers of lead, zinc, and tin feel that present prices are high enough for the good of the industry; on the other hand, copper producers in general would like to see that metal a cent or two higher.

Daily Prices of Metals

Dec.	Copper N. Y. net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N.Y.	St. L.	St. L.
24	13.90	62.125	63.125	9.25	9.10	8.40@8.70
25	Holiday	.....	.....	....	....	.....
26	13.90	62.125	63.125	9.25	9.10	8.40@8.70
28	13.90	62.25	63.25	9.25	9.10	8.40@8.70
29	13.90	62.00	63.00	9.25	9.10	8.40@8.70
30	13.875	62.375	63.375	9.25	9.10	8.40@8.70
Av.	13.895	62.175	63.175	9.25	9.10	8.55

*The prices correspond to the following quotations for copper delivered: Dec. 24th, 14.15c.; 25th, Holiday; 26th, 28th and 29th, 14.15c.; 30th, 14.125c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

The quotations are arrived at by a committee consisting of the market editors of *Mining Journal-Press* and a special representative of the Bureau of Mines and the Bureau of Foreign and Domestic Commerce.

London

Dec.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3M		Spot	3M	Spot	3M	Spot	3M
24	59 7/8	61	65 1/2	288	280 3/4	35	34 13/16	38 9/16	37 3/4
25	Holiday	...	...	....	....	....	....	....	....
28	59 3/4	60 7/8	65 3/4	289	281 1/4	35 5/16	35 1/16	38 3/4	38
29	59 1/4	60 3/8	65 1/2	287	280	35 3/8	35 9/16	39	37 15/16
30	59 3/8	60 3/8	65 1/2	287 3/4	280 5/8	35 5/16	35 1/4	38 3/4	37 15/16

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver, Gold, and Sterling Exchange

Dec.	Sterling Exchange "Checks"	Silver		Gold London	Dec.	Sterling Exchange "Checks"	Silver		Gold London
		New York	London				New York	London	
24	4.84 1/2	68 1/2	31 11/16	84s11 1/2d	28	4.84 5/8	68 1/2	31 11/16	84s11 1/2d
25	Holiday	...	....	.....	29	4.84 5/8	68 3/8	31 9/16	84s11d
26	4.84 1/2	68 5/8	....	.....	30	4.84 3/4	68 3/8	31 1/2	84s10 1/2d

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London silver quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command three-eighths cent premium.

Copper Sales Insignificant

The large copper producers have made no effort to sell in the week ending today, recognizing the futility of trying to do business before the new year. They are nominally either at the 14⅛ or 14¼c. delivered level, for Connecticut points, and an eighth of a cent higher in the Middle West, but only an occasional small order has been placed at these levels. In a mild attempt to sell copper in the last three days by one producer, he was unable to realize more than 14.075c., Valley, and it is reported that a little second-hand copper has been picked up at 13.85c., f.o.b. refinery. Today, 14⅛c. could be done in more than one direction, and sales of modest tonnages have been made at that price for Valley deliveries, first-quarter shipment.

The foreign market has been equally quiet, with small orders booked on the Continent by American agencies at 14.325c., c.i.f., and dealers asking about 14.30c.

Lead Firm at 9¼c.

Lead prices show little or no quotable change from last week, though the metal is gradually getting into a stronger and stronger position, thanks to the strength shown in London. That market has apparently been affected by its curtailed supply, brought about by the importation of foreign ore lead into the United States that has formerly gone to Europe. Spot metal is virtually impossible to obtain in either the New York or St. Louis market, and premiums of from 10 to 20 points are named by dealers for deliveries before the end of January, but sales at these higher prices are insignificant. The American Smelting & Refining Co. is continuing its official contract price of 9.25c., New York, and sales for practically all deliveries except spot are being made at that level, though orders for shipment later than February are not invited. Most all of the business

in the Middle West has been done by one producer, who continues to sell at 9.10c., St. Louis. January lead is offered by others at 9.125@9.15c. Desilverized commands a premium of 10 to 15 points.

Zinc Unchanged

Only a few hundred tons of zinc has been sold in the week ending today, the price level being practically unchanged. Prompt has sold for 8.70c., January 8.575@8.60c., February, 8.55c.; and March, 8.40c. High-grade is unchanged at 10¼@10½c.

Tin Close to 63c.

Tin also has been quiet, both here and in London, an important seller reporting a total of 25 tons for the week. Prices have been virtually unchanged, at 63@63½c., with forward tin about half a cent less.

Silver Heavy

London has declined during the past week on account of some selling on the part of the Indian bazaars, but the chief cause has been the general inactivity due to the Christmas and New Year holidays. This condition has of course been reflected in New York, but buying orders on the 29th and 30th for San Francisco delivery and the continued reluctance of sellers to meet the decline have prevented the movement from going very far locally.

Mexican Dollars: Dec. 24th, 52½c.; 25th, holiday; 26th, 52⅝c.; 28th, 52½c.; 29th and 30th, 52⅜c.

Francs Improve a Little

Closing cable quotations on Tuesday, Dec. 29, for the principal foreign exchanges were: francs, 3.735c.; lire, 4.04c.; and marks, 23.81c. Canadian dollars, ⅜ per cent discount.

Other Metals

Quotations cover large wholesale lots unless otherwise specified.

Aluminum—99 per cent grade, 29c. per lb.; 98 per cent, 28c. London, 98 per cent, £118 per long ton.

Antimony — Per pound, f.o.b. New York: Chinese brands, spot, 22½@23⅜c. February arrival, 22@23¼c. Cookson's "C" grade, spot, 22½@23½c. Chinese needle, lump, 17@18c. Standard powdered needle, 200 mesh, 20@21c. White oxide, Chinese, 99 per cent Sb_2O_3, 20c. Sellers contend that current "high" prices are justified by small offerings from China.

Bismuth—$3.30@$3.35 per lb., in ton lots. London, 12s. 6d.

Cadmium—60c. per lb. London, 1s. 9d. for Australian metal.

Iridium — $380@$390 per oz. for 98@99 per cent. Nominal. London £80@£85 for 99.5 per cent.

Nickel—Ingot, 34c.; shot, 35c.; electrolytic, 38c. (99.75 per cent); London, £170@£175 per long ton. On 1926 contracts, an advance of 2c. is reported.

Platinum—$120 per oz. refined officially quoted. Sales also at $115@$118. Crude, $114@114.75. London, £24 @£25 for refined; crude £21½@£22½.

Quicksilver — Per 75-lb. flask: $89@$90 for spot; forward, $88@$89. San Francisco $89.67. London, £15@£15¼.

The prices of Cobalt, Germanium Oxide, Lithium, Magnesium, Molybdenum, Monel Metal, Osmium, Palladium, Radium, Rhodium, Ruthenium, Selenium, Tantalum, Tellurium, Thallium, Tungsten, and Zirconium are unchanged from the issue of Dec. 5.

Metallic Ores

Manganese Ore—Per long ton unit of Mn, c.i.f. North Atlantic ports: Caucasian, Bolivian, and Chilean, 40@42c.; nominal.

Tungsten Ore—Per unit of WO_3, N.Y.: **Wolframite, $11.50@$12.50; Western** scheelite, $12@$12.75. Domestic demand very light, market supported by good European demand.

Chrome Ore, Galena and Pyrite Radio Crystals, Iron Ore, Molybdenum, Tantalum, and Vanadium Ores are unchanged from quotations in the Dec. 5 issue.

No Change in Prices of Zinc Blende and Lead Ore

Joplin, Mo., Dec. 26, 1925

Zinc Blende	Per Ton
High	$ 61.60
Premium blende, basis 60 cent zinc	$57.00@$58.00
Prime Western, basis 60 per cent zinc	$56.00
Fines and slimes, 60 per cent zinc	$54.00@$ 51.00
Average settling price, all zinc	$56.37
Galena	
High	$122.00
Basis 80 per cent lead	$115.00
Average settling price, all lead	$119.07

Shipments for the week: Blende, 15,941; lead, 4,625 tons. Value, all ores the week, $1,450,000.

Shipments for the year: Blende, 817,549; calamine, 1,645; lead, 130,408 tons. Value all ores the year, $58,747,490.

Some mines were closed down Wednesday and all others on Thursday evening. Some will resume Monday morning, Dec. 28; some will remain closed down six days, and a few, it is reported, will remain closed until Monday, Jan. 3, 1926. The output was lowered from 17,900 tons last week to 12,800 tons this week by this action. The probable output next week is estimated at 5,000 to 8,000 tons.

Buyers of lead reported that sellers were anxious to market ore this week, but not all were willing to accept the $115 basis price.

Platteville, Wis., Dec. 26, 1925

Zinc Blende	Per Ton
Blende, basis 60 per cent zinc	$ 58.50
Lead Ore	
Lead, basis 80 per cent lead	$120.00

Shipments for the week: Blende, 841 tons; lead, none. Shipments for the year: Blende, 48,416; lead, 2,371 tons. Shipments for the week to separating plants, 1,731 tons blende.

Non-Metallic Minerals

Amblygonite, Andalusite, Asbestos, Barytes, Bauxite, Borax, Celestite, Chalk, China Clay, Diatomaceous Earth, Emery, Feldspar, Fluorspar, Fuller's Earth, Garnet, Gilsonite, Graphite, Greensand, Gypsum, Ilmenite, Iron Oxide, Lepidolite, Limestone, Magnesite, Manjak, Mica, Monazite, Ocher, Phosphate, Potash, Pumice, Pyrites, Quartz Rock Crystals, Rutile, Silica, Spodumene, Sulphur, Talc, Tripoli, and Zircon are unchanged from prices in the Dec. 5 issue.

Mineral Products

Arsenious Oxide (White arsenic)—3@3¼c. per lb. London, £14½@£15 per long ton.

Copper Sulphate, Sodium Nitrate, Sodium Sulphate, and Zinc Oxide are unchanged from prices in the Dec. 5 issue.

Ferro-Alloys

Ferrocerium, Ferrochrome, Ferromanganese, Ferrophosphorus, Ferrosilicon, Ferrotitanium, Ferrotungsten, Ferro-uranium and Ferrovanadium are unchanged from the prices in the Dec. 5 issue.

Metal Products

Rolled Copper—Sheets, 22½c.; wire, base price, 16c. per lb.

Lead Sheets—Full, 13c. per lb.; cut, 13¼c.

Nickel Silver—29½c. per lb. for 18 per cent nickel Grade A sheets.

Yellow (Muntz) Metal — Dimension sheets, 20½c. per lb.; rods, 17½c.

Zinc Sheets—12c. per lb., f.o.b. works.

Refractories

Chrome Brick, Firebrick, Magnesite Brick, Silica Brick, and Zirkite are unchanged from prices in the Dec. 5 issue.

Steel Steady—Pig Iron Dull—Coke Higher

Pittsburgh, Dec. 29, 1925

The steel trade has been quiet in the last week, with no developments of consequence. Buying almost invariably becomes light as Jan. 1 is approached, with its annual inventory and various adjustments.

The steel mills have been well supplied with rolling orders and have had no occasion to curtail production on account of the state of order books. Pipe mills and wire mills have been engaged in replenishing stocks in certian of their lines, and variations in the rate of shipment need not be reflected in operations. In the sheet trade, there have been various suspensions as to automobile sheets, but capacity seems simply to have been turned to other descriptions of sheets.

Finished steel prices are steady to firm all along the line, and fully as strong as at any time in recent weeks.

Pig Iron—The market has continued quiet, with furnaces only moderately well sold up. Two or three merchant stacks in this district are resuming. Prices are unchanged: Bessemer, $21; basic, $20; foundry, $20.50, f.o.b. Valley furnaces.

Connellsville Coke—The market advanced to $6 for ordinary furnace coke and $8 to $9 for coke prepared for domestic use just before Christmas, since when the market has been inactive, with production curtailed by the holiday.

Company Reports

Smuggler Union Position Much Improved

A marked improvement in the ore-reserve position is the feature of the current report of the Smuggler Union Mining Co., which produces gold, silver, lead, and copper at Telluride, Colo. On Jan. 31, 1925, a report stated that the ore reserves were apparently exhausted.

During the year ended April 30, 1925, 177,720 tons of ore was produced, from which were recovered 36,038 oz. of gold, 249,543 oz. of silver, 3,373,352 lb. of lead, and 1,298 lb. of copper. In addition, lessees produced 22,940 tons of ore, from which were recovered 5,033 oz. of gold, 253,211 oz. of silver, 354,524 lb. of lead, and 14,125 lb. of copper, making a total production on combined company and lessees' accounts of 200,660 tons of ore, containing in recovered metals 41,071 oz. of gold, 502,754 oz. of silver, 3,727,876 lb. of lead, and 15,423 lb. of copper.

The average price received for metals during the year was as follows: gold, $20.298 per ounce; silver, $0.649 per ounce; lead, $0.0622 per pound; copper, $0.081 per pound. The increased production of lead over previous years and the better price received helped the returns materially, but a silver content of the ore lower than usual has somewhat offset this gain.

The gross extracted value of ore produced on company account during the year was $1,110,301.42. Freight and treatment charges amounted to $192,153.37, leaving a total net value of $918,148.05. Additional receipts incident to operations amounted to $9,312.19, and $40,211.98 was received in royalties from lessees, making total gross receipts of $967,672.22, after deduction of freight and treatment charges.

A tabulation of receipts and expenditures on the basis of tons of ore produced by the company follows:

		Per Ton
Receipts		
Gross extracted value	$1,110,301.42	$6.25
Freight and treatment	192,153.37	1.08
Net value	$918,148.05	$5.17
Incidental receipts	9,312.19	.05
Royalties from lessees	40,211.98	.23
Total receipts	$967,672.22	$5.45
Expenditures		
Direct operating charges	$762,576.47	$4.29
Indirect and incidental operating charges	86,597.07	.49
Boston office expenditures	17,479.20	.10
Total expenses	$866,652.74	$4.88
Net operating profit	101,019.48	0.57

Net interest charges, amounting for the year to $12,718.04, depreciation, and depletion are not included in the above tabulation. The sum of $34,475.89 was spent in construction of the Pennsylvania buildings and tramway, which, being a capital charge, is not included in operating costs, but which, nevertheless, was paid for out of earnings and reduces the apparent gain by the amount named. Although the ore reserves above the Bullion level were expected to last only until the ground below could be opened up, development and stoping have proved up a great deal more than was anticipated, and the major production is still coming from that part of the mine.

The policy has been to work out the blocks in the upper levels first, removing equipment and withdrawing downward, and turning over pillars and small blocks unprofitable to mine on a company basis, to lessees, thus deriving a considerable tonnage of ore from ground that would otherwise be abandoned, at no expense in mining or maintenance.

Eventually it is to be expected that the production will come entirely from the levels below the Bullion level, and that the main working level and principal exit for ore will then be the Pennsylvania, but that time is still far away, and new development may postpone it indefinitely.

Below the 13 level to the Pennsylvania level 585 shaft is not yet reconditioned, but will be during the current year, after which there will be a through hoist between the Pennsylvania and Bullion levels. This will ease up greatly on present congested conditions.

On the Pennsylvania or 15 level, stopes have been opened, and indications are favorable for a good reserve of ore. Electrical haulage has been installed, and a ditch has been cut to handle the water, which at this level is more than half the entire flow in the mine. Bins, sorting plant, trackage, and buildings are completed and are sufficient for the present stage of development.

An estimate of ore reserves as of May 1, 1925, follows:

	Tons	Value per Ton	Total Value
Total proven ore	100,880	$7.96	$802,820.57
Total probable ore	58,325	7.30	425,538.78
Total broken ore	31,662	4.67	147,985.66
Totals	190,876	$7.21	$1,376,345.01

Referring to the statement of Jan. 31, 1925, in which it was said that ore reserves were apparently exhausted, the greatly improved condition of the reserves shown in this report has been brought about partly by re-examination and inclusion of existing developed blocks made accessible by reopening old workings; partly by proving up stopes which were not thought to be profitable and which had been abandoned; and partly by development in new territory.

The estimate given, although divided into "proven" and "probable" ore from technical considerations, has been so conservatively made that there seems no reason not to call it all "positive" ore. No account has been taken of "possible" ore, and without some mention of that feature the present estimate, giving only about a year's run, is not a true criterion of the future.

The past year, according to Robert Livermore, president and general manager, has been one of building up after a severe financial crisis, and the results accomplished are reflected in the present condition of the mine and in the improved financial status. There is still much to be done, but it is confidently hoped that a moderate but steady profit can be made, and that payments on the bonds, notes, and stockholders' loans can soon be resumed. The following shows the financial results of operations during the year:

Cash on hand May 1, 1924		$26,035.14
Profit on operations for the year, not including in expenses any charges for interest, depreciation or depletion	$101,019.48	
Deduct interest charge for year	12,718.04	
	88,301.00	
Deduct amount still in accounts receivable (increase in operating accounts receivable during year)	20,239.55	
	$68,061.89	
Add net amounts charged into expense through reserves during year for insurance, taxes and interest, in excess of amounts paid	31,757.94	
And amount derived from reduction of supplies on hand	19,566.12	119,385.95
Making cash available		$181,421.09
Of which there was used for reduction of accounts payable	$73,763.87	
Construction	34,857.09	108,620.96
Leaving cash on hand April 30, 1925		$72,800.13
Cash April 30, 1925, as above		$72,800.13
There was also due the company for concentrates already shipped April 30, 1925 (eliminating other accounts receivable amounting to $34,635.94) immediately convertible to cash		69,118.05
		$141,918.18
Open accounts payable April 30, 1925		85,427.94
Supplies on hand April 30, 1925		$103,794.67
Old debt consisting of debentures, notes, and stockholders loans	$166,837.70	
On which interest accrued to April 30, 1925, was	53,900.45	$220,738.15

St. Joseph Lead Declares 1926 Dividends

At a meeting of the Board of Trustees of the St. Joseph Lead Co. held on Dec. 17, 1925, a dividend of $2 per share on the outstanding capital stock of the company payable quarterly during the year 1926 was declared payable as follows:

Fifty cents per share on March 20, 1926, to stockholders of record at the close of business on March 9, 1926.

Fifty cents per share on June 21, 1926, to stockholders of record at the close of business on June 9, 1926.

Fifty cents per share on Sept. 20, 1926, to stockholders of record at the close of business on Sept. 9, 1926.

Fifty cents per share on Dec. 20, 1926, to stockholders of record at the close of business on Dec. 9, 1926.

Also an extra dividend of $1 per share on the outstanding capital stock of the company, payable quarterly on the same dates and to stockholders of record on the same dates as those given for the respective payments.

Federal Mining & Smelting Co. Earnings Up

The Federal Mining & Smelting Co., mining silver, lead, and zinc in Idaho, and zinc in Oklahoma, during the quarter ended Oct. 31, 1925, made the following shipments compared with the preceding quarter and with the same period last year:

Quarter Ended Oct. 31, 1925		Quarter Ended July 31, 1925		Quarter Ended Oct. 31, 1924	
1925		1925		1924	
August	14,643	May	12,937	August	4,147
September	16,251	June	12,286	September	15,215
October	16,589	July	12,230	October	15,872
Total	47,483	Total	37,453	Total	45,234

Net earnings, before depletion, depreciation and taxes are shown in the following table:

Quarter Ended Oct. 31, 1925		Quarter Ended July 31, 1925		Quarter Ended Oct. 31, 1924	
1925		1925		1924	
Aug.	$384,615.32	May	$309,311.44	Aug.	$262,231.90
Sept.	422,069.92	June	273,938.79	Sept.	285,853.57
Oct.	501,383.01	July	247,292.42	Oct.	350,746.91
Total (*a*)	$1,308,068.25	Total (*b*)	$830,542.65	Total (*c*)	$898,832.38

(*a*) Before deducting $67,954.26 for construction and equipment.
(*b*) Before deducting $81,486.70 for construction and equipment
(*c*) Before deducting $90,583.31 for construction and equipment

Hoboken (Belgium) Reduction Works Busy

According to the current report, the Société Générale Metallurgique de Hoboken, of which the Union Minière du Haut-Katanga is part owner, net profit for the year has been 3,791,385 francs. Dividend disbursements amounted to 10 per cent. Capital is to be increased by 12,000,000 francs to 40,000,000 francs. The report states that during the financial year ended June 30 last, its various branches were employed actively, including the copper, lead, and silver works at Hoboken, and the arsenic and bichromate plants at Reppel and Oolen. At the Hoboken tin smelter, cassiterite produced by the Union Minière du Haut-Katanga and other Katanga mining concerns was treated.

The Oolen radium works received regular supplies of ore, and now supplies four-fifths of the world's demand. The cobalt works plant has been put into operation, and the supply of raw material from Katanga is assured, so that from now onward it will be able to market considerable quantities of cobalt metal and salts.

Auction Sales of Mining Stocks

The following sales of stocks and bonds of various mining companies have been made in New York recently. The price quoted is for the entire lot.

Judgment in favor of Metals Exploration Co. against Colorado Superior Mining Co. for $5,257.77 entered on March 5, 1924, in the District Court of the City of Denver, Colo.	$10
333 shares Shasta Zinc & Copper Co., et al.	10
$10,000 certificate of deposit of securities guaranteed by Compania Metalurgica Mexicana, issued by Spencer Trask & Co.	175
$6,000 New England Minerals Co. 1st mtg. 8 per cent s. f. bonds, due Oct. 1, 1938.	360
1,485 shares Calumet & Massey Copper Co., Inc.	1
200 shares Calumet & Massey Copper Co., Inc.	1
11,650 shares Trinity Gold Mining & Reduction Co.	3
$300 Alaska Gold Mines convt., 6s "A" 1925, March, 1918, coupon on	10
Receipt for 96 shares Pacific Copper Co.	2
300 shares Phosphate Mining Co.	300
250 shares Colorado Fluorspar Corp. of Delaware, Class A.	2,500
787 38-100 shares Colorado Fluorspar Corporation of Delaware, Class B.	787
500 shares Phosphate Mining Co.	1,500
800 shares Phosphate Mining Co.	4,000
200 shares Chontales Mines, Ltd.	10
50 shares Ohio Copper Mining Co. and 300 shares Keweenaw Copper Co.	18
40 shares Consolidated Arizona Smelting Co., 12,000 shares Meridian Petroleum Corporation.	6
$15,000 General Mines Corporation of Bolivia 7 per cent collateral trust bonds, due 1934, all coupons on, and 570 shares General Mines Corporation of Bolivia.	1,500
202,254 shares Golden Reward Consolidated Gold Mining & Milling Co.	1,000
157 shares Goldfield Development Co. Assessment No. 7 paid, 13,415 shares Goldfield Deep Mines Co. Assessment No. 7 paid, 1,000 rubles Russian Goldfield Consolidated Mines Co., 1,100 shares Tramp Consolidated Mining Co., 1,700 shares Montgomery Shoshone Consolidated Mining Co., 100 shares South Utah Mines & Smelters, 400 shares Mitchell Mining Co., et al.	110
7,000 shares Unity Gold Mines, et al.	2,000
4,000 shares Unity Gold Mines, et al.	1,500
82,400 shares Eureka-Swansea Extension Mining Co.	25
$2,000 The Comstock Tunnel Co. first mortgage 4 per cent income bonds, due September, 1919; May, 1892, coupon on	40
500 shares Butte-New York Copper Co.	10
500 shares Bullion Mining Co., Salt Lake City, Utah	3

World Zinc Supply Increases

By A. J. M. Sharpe

Honorary Foreign Correspondent of the American Zinc Institute

Absence on the Continent has prevented the compilation of my monthly survey in the first days of December, and at time of dictation the middle of the month is close at hand. I, therefore, do not propose to report at length today in view of the imminence of the survey I shall be preparing on Jan. 1.

I have returned to London to find the zinc market in a curiously anomalous position, inasmuch as the statistical position is very little changed, and yet the quotation is over £3 below the St. Louis parity.

The London Metal Exchange has been upset by a succession of more or less extraneous conditions: first, the approach of the end of the year has quieted down buying in all metals; second, the zinc market is especially depressed by rumors of further large accumulations in Germany and Poland; and, third, some Silesian metal shipped from Stettin to London has been declared against speculative contracts and, with these buyers not caring to take it up, the metal has promptly been resold at a price sacrifice. London, in any case, is a bad port for zinc arrivals, as the metal has to be transshipped to the consuming centers in Britain. Thus we have the position today of a surplus of zinc available in London and a shortage at Liverpool. These Polish shipments to London have been inspired, too, by merchants interested in ore purchases, and the effect on London quotations has operated to the advantage of contract buyers of ore on terms based on London prices of metal.

It is true that the deplorable condition of trade and industry in Germany has resulted in stocks of zinc in Poland and Germany increasing to 15,000 tons, but the bulk of this is tied up through inability to transport it owing to the canals being frozen. It can, of course, be moved by rail at a price, but the cost is exorbitant.

As matters stand, unless a fair tonnage can be landed in England from the Continent in January, British consumers may experience some difficulty in filling their needs up to the end of that month. They have covered their requirements through dealers, who in turn have bought on the market, but these paper contracts are unlikely to result in the declaration of much actual metal. If the St. Louis market were to suffer a serious decline, the position could be quickly remedied by importing the necessary quantity of American metal.

I estimate world stocks of zinc on Dec. 1 at 29,200 metric tons. [This compares with 25,600 at Nov. 1.—Editor]. Distribution of the metal is as follows:

Country	Metric Tons
United States	6,300
Germany and Poland	15,000
Canada	1,000
Great Britain	1,000
Belgium	1,900
France	800
Scandinavia	200
Australia (including unsold shipments afloat)	2,000
Far East	500
Elsewhere	500
Total	29,200

November Lead Production Down

The following figures from the American Bureau of Metal Statistics, in tons of 2,000 lb., show the monthly output of pig lead by important countries which in 1924 produced about 79 per cent of world's total.

	July	Aug.	Sept.	Oct.	Nov.	Jan.-Nov.
United States (*a*)	46,552	46,223	44,334	52,927	50,033	521,332
Mexico	17,208	16,635	16,997	17,818	16,345	186,789
Canada	9,466	10,118	9,905	11,122	10,835	113,507
Total North America	73,226	72,976	71,236	81,867	77,213	821,628
Spain and Tunis (*b*)	9,216	8,213	10,567	11,228	10,712	116,139
Italy	2,289	2,590	1,984	2,263	2,162(*d*)	14,348
Australia	14,465	13,088	15,378	15,658	16,000	151,259
Burma	4,260	4,260	4,480	4,481	4,920	48,345
Rhodesia	680	620	451	430	222	3,270
Transvaal	168	194	86	100(*c*)	110(*d*)	1,450
Totals	104,304	101,941	104,182	116,027	111,329	1,156,439

(*a*) Crude lead; includes only production reported by smelters who are members of this bureau. Pig lead produced from Canadian and Mexican ores has been deducted and credited to its country of origin. (*b*) Partial. (*c*) Estimated. (*d*) Partly estimated.

Mining Stocks—Week Ended December 26, 1925

Stock	Exch.	High	Low	Last	Last	Div.
COPPER						
Anaconda	New York	50⅛	47¼	50	Ja.16,Fe.23,Q	0.75
Arcadian Consol.	Boston	*75	*75	*75		
Ariz. Com'l.	Boston	12⅛	12⅛	12⅜	Jy.21,Jy. 31 SA	0.50
Calaveras	N. Y. Curb	3⅜	3⅜	3⅜		
Calumet & Arizona	New York	57⅛	56¼	57⅛	De.4, De.21 QX	1.50
Calumet & Hecla	Boston	13⅜	13⅜	13⅝	Nov 30,De.15 Q	0.50
Cerro de Pasco	New York	63¼	59½	62½	De.10, De.22,X	1.00
Chile Copper	New York	34	33⅝	33⅞	Dec.2, Dec.28, Q	0.62½
Chino	New York	19½	19⅛	19½	Sept., 1920	0.37½
Con. Coppermines	N. Y. Curb	2	1⅞	2		
Copper Range	Boston	18⅞	18	18⅛	May, 1925	1.00
Crystal Copper	Boston Curb	*47	*46	*46		
East Butte	Boston	3 5/16	3	3½	Dec., 1919	0.50
First National	Boston Curb	*22	*20	*20	Feb., 1919	0.15
Franklin	Boston	*90	*90	*90		
Granby Consol.	New York	20⅞	20⅛	20⅜	May, 1919	1.25
Greene-Cananea	New York	12¼	12⅛	12⅜	Nov., 1920	0.50
Hancock	Boston	*80	*80	*80		
HoweSound.new,r.t.c.	New York	27½	26⅞	27	Oc.5, Oc. 15 Q	0.50
Inspiration Consl.	New York	25⅛	23½	24½	De.17, Ja.4, Q	0.50
Iron Cap	Boston Curb	2¼	2¼	2⅛	May, 1923	0.15
Isle Royale	Boston	12	11½	11⅝	No.30, De.5	1.00
Jerome Verde Dev.	N. Y. Curb	*93	*81	*87		
Kennecott	New York	56⅜	53⅛	56¼	De.4,Jan.2 Q	1.00
Lake Copper	Boston	1⅛	1 1/16	1 1/16	June, 1925	0.50
Magma Copper	New York	43⅜	42⅜	43⅛	De.31, Ja.15,	0.75
Mason Valley	N. Y. Curb	1⅜	1⅜	1⅜		
Mass Consolidated	Boston	*50	*50	*50	Nov., 1917	1.00
Miami Copper	New York	12⅞	12	12⅜	No.2, No.16 Q	0.25
Mohawk	Boston	33	32	32⅜	Oc.31, De.2	1.00
Mother Lode Coa.	New York	7⅛	7	7⅛	De. 11, De. 31	0.37½
Nevada Consol.	New York	13¼	12⅛	13⅛	De. 18, De.31 Q	0.25
New Cornelia	Boston	19	18⅜	19	No.6, No.23 Q	0.25
North Butte	Boston	2⅜	2⅛	2⅛	Oct., 1918	0.25
Ohio Copper	N. Y. Curb	*75	*75	*75	No. 14, De. 2	0.05
Old Dominion	Boston	18⅛	17⅜	18⅛	Dec., 1918	1.00
Phelps Dodge	Open Mar.	†127	†123	....	De.21, Ja.2 Q	1.00
Quincy	Boston	24⅛	21⅞	22	Mar., 1920	1.00
Ray Consolidated	New York	12¼	11⅝	12⅛	Dec., 1920	0.25
Ray Hercules	N. Y. Curb	....	....	14	....	....
St. Mary's Min. Ld.	Boston	35⅝	34	35⅜	May, 1925	3.00
Seneca Copper	Boston	9⅜	9⅜	9⅜	....	....
Shannon	Boston	*70	*60	*60	Nov., 1917	0.25
Shattuck Arizona	New York	72	68¼	72	Jan.,'1920	0.25
Superior & Boston	Boston	*75	*75	*75	....	....
Tenn. C. & C.	New York	14⅜	13⅝	14	De.31, Ja.15,Q	0.25
United Verde Ex.	N. Y. Curb	28⅝	27⅝	27¾	Ja.5, Fe.1, Q	0.75
Utah Copper	New York	....	....	103	De.18, De.31, Q	1.25
Utah Metal & T.	Boston	*70	*55	*67	Dec., 1917	0.30
Victoria	Boston	....	....	*30	....	....
Walker Mining	Salt Lake	1.55	1.47½	1.55	....	....
NICKEL-COPPER						
Internat. Nickel	New York	45⅝	42⅝	45	De.17,De.31,Q	0.50
Internat. Nickel, pfd.	New York	....	....	101½	Oc.15, No.2, Q	1.50
LEAD						
Gladstone M. M. Co.	Spokane	*30½	*29½	*30½	No. 1, No. 10 M	0.01½
National Lead	New York	165½	164	165	De.11, De.31 Q	2.00
National Lead pfd.	New York	116¼	116¼	116¼	Aug.21, Se.15	1.75
St. Joseph Lead	New York	46¼	44⅜	46⅜	De.10,De.20QX	1.50
ZINC						
Am. Z. L. & S.	New York	9⅛	8⅝	8⅝	May., 1920	1.00
Am. Z. L. & S, pfd.	New York	40	37½	38⅜	Nov., 1920	1.50
Butte C. & Z.	New York	5⅝	5⅛	5⅛	De.10, De.24	0.50
Butte & Superior	New York	15⅞	14	15½	De.15, De.31 Q	0.50
Callahan Zn-Ld	New York	2	1⅞	2	Dec., 1920	0.50
Eagle Picher	Cincinnati	35⅛	34⅛	35⅛	De.1, De.31	0.40
Eagle Picher, pfd.	Cincinnati	....	....	110	....	....
New Jersey Zn.	N. Y. Curb	....	....	207½	No.20,Dec.10 X	2.00
United Zinc	N. Y. Curb	*70	*70	*70	....	....
Yellow Pine	Los Angeles	*45	*32	*45	Se.10 Se.21 Q	0.04
GOLD						
Alaska Juneau	New York	1⅞	1⅝	1⅞	....	....
Argonaut	Toronto	*16	*15½	*15½	....	....
Barry-Hollinger	Toronto	*25½	*24	*25	....	....
Carson Hill	Boston	*55	*40	*41	....	....
Consol. W. Dome L.	Toronto	*19½	*17½	*18½	....	....
Cresson Consol. G.	N. Y. Curb	2⅜	2⅛	2⅜	Se.30, Oc.10	0.10
Crown Reserve	Toronto	*19½	*18	*18½	Jan., 1917	0.05
Dome Mines	New York	17	16½	17	De.31, Ja.20, Q	0.50
Golden Cycle	Colo. Springs	†1.61	†1.58½	....	No. 30, Dec.10 Q	0.03
Hollinger Consol.	Toronto	17.25	17.15	17.20	De.14, De.31	0.08
Homestake Mining	New York	48	47½	47½	De.19, De.26 M	0.50
Kirkland Lake	Toronto	*84	*78	*81	....	....
Lake Shore	Toronto	9.34	8.95	9.00	De.1,De.15 XQ	0.10
McIntyre-Porcupine	New York	22½	22⅛	22⅜	No.2, De.1 Q	0.25
Newray	Toronto	*38	*36	*37	....	....
Night Hawk Pen.	Toronto	*7	*6	*6	....	....
Portland	Colo. Springs	†*65	†*63	....	Oct., 1920	0.01
Rand Mines	New York	34½	34½	34½	Au.17, Au.25	1.52
Teck-Hughes	Toronto	2.44	2.40	2.42	Ja. 15, Fe. 1	0.05
Tom Reed	Los Angeles	*55	*55	*55	Dec., 1919	0.02
Tough-Oakes	Toronto	*51¼	*51	*51	....	....
United Eastern	N. Y. Curb	....	....	*45	July, 1924	0.05
Vipond Cons.	Toronto	1.54	1.50	1.52	....	....
Wright-Hargreaves	Toronto	7.70	7.50	7.65	De.15, Ja. 1 QX	0.10
GOLD AND SILVER						
Black Oak	N. Y. Curb	....	....	*81	....	....
Carnegie Metals	Pittsburgh	18⅝	18⅝	18⅝	....	....
Con. Cortez	N. Y. Curb	*5	*5	*5	....	....
Con. Virginia	San Francisco	*22½	*17½	*22½	....	....
Continental Mines	N. Y. Curb	....	....	*45	....	....
Dolores Esperanza	N. Y. Curb	*79	*70	*79	July, 1923	0.05
Premier Gold	N. Y. Curb	2½	2½	2½	De.18, Ja. 4	0.08
Tonopah Belmont	N. Y. Curb	*2⅜	*2⅜	*2⅜	Se.15, Oc.1	0.05
Tonopah Divide	N. Y. Curb	....	....	*23	Oct., 1923	0.10
Tonopah Extension	N. Y. Curb	1⅜	1 3/16	1⅛	Apr. 1925	0.05
Tonopah Mining	N. Y. Curb	4⅜	4⅛	4⅜	Se.30, Oc.21	0.07½
Unity Gold	N. Y. Curb	....	....	*50	....	....
West End Consol.	N. Y. Curb	....	....	*30	Mar., 1923	0.05
Yukon Gold	N. Y. Curb	....	....	*.50	June, 1918	0.02

Stock	Exch.	High	Low	Last	Last	Div.
SILVER						
Alvarado	N. Y. Curb	....	....	*76	Oct., 1920	0.50
Beaver Consol	Toronto	*53½	*50	*50	May. 1920	0.03
Castle-Trethewey	Toronto	1.49	1.43	1.43	....	....
Coniagas	Toronto	4.50	4.10	4.25	May, 1924	0.12½
Keeley	Toronto	1.63	1.62	1.62	Au.31,Se.15 X	0.12
Kerr Lake	N. Y. Curb	1¼	1	1⅛	Oc. 1, Oc.15 Q	0.12½
La Rose	Toronto	*39	*37½	*38¾	Apr., 1922	0.10½
Lorrain Trout Lake	Toronto	1.10	*95	*95	Jy. 2, Jy. 15	0.05
McKinley-Dar.-Sav.	Toronto	*22½	*22½	*22½	Oct., 1920	0.03
Mining Corp. Can.	Toronto	3.18	3.17	3.17	Ja. 16, Ja.30	0.12½
Nipissing	N. Y. Curb	6¼	6	6¼	De.31, Ja.2, Q	0.15
Temiskaming	Toronto	*13	*12	*12	Jan., 1920	0.40
SILVER-LEAD						
Ahumada	New York	9½	8½	8⅞	De.15,Ja.2, X	0.25
Alta Merger	Salt Lake	†5	†3½	....	....	....
Bingham Mines	Boston	55¾	53	55	De.19, De.20 Q	1.00
Cardiff M. & M.	Salt Lake	*56	*55	*56	De.16, No.18	0.10
Chief Consol.	Salt Lake	....	....	3.80	Oc. 10, No. 1	0.10
Emma Silver	Salt Lake	†1½	†1	....	....	....
Erupcion	Boston Curb	1⅛	1⅛	1⅛	De.15, Ja.2, X	0.10
Federal M. & S.	New York	93	76¾	91	No.25, De.15 Q	1.75
Federal M. & S., pfd.	New York	99½	95½	99½	Au.25, Se.15	1.75
Hecla Mining	N. Y. Curb	17⅞	17⅞	17⅞	No.15, De.15 Q	0.50
Iron King Mining	Salt Lake	*36	*34	*36	....	....
Keystone Mining	Salt Lake	*63	*63	*63	Au.12, Au.26	0.07½
Lucky Jim	Spokane	*12¾	*12¼	*12¼	....	....
Mammoth Mining	Salt Lake	2.80	2.80	2.80	De. 16, De. 23	0.10
Marsh Mines	Spokane	*7¼	*7¼	*7¼	Se.15, Oc.1	0.15
Park Utah	Salt Lake	7.80	7.20	7.80	Se.15, Oc.1	0.15
Silver King Coal	Salt Lake	9.55	9.55	9.55	De.15, Ja.2, QX	0.35
Silversmith	Spokane	*38¾	*36	*38¾	Oc.1, Oc.10	0.01
Tamarack-Custer	Spokane	*35	*32	*35	Sept., 1924	0.25
Tintic Standard	Salt Lake	13.87½	13.75	13.87½	De.16,De.23,QX	0.50
Utah-Apex	Boston	6¾	6¼	6¾	Oc.3, Oc.15, Q	0.35
Western Utah Copper	N. Y. Curb	....	....	*10	....	....
IRON						
Bethlehem Steel	New York	48⅞	46⅝	47½	July, 1924	1.25
Colorado Fuel & Iron	New York	37¼	36	37¼	May, 1921	0.75
Gt. North'n Iron Ore	New York	27	26⅛	26⅛	De. 4, De. 28.	0.75
Inland Steel	New York	43⅞	43	43⅞	No.13, De.1 Q	0.62½
Mesabi Iron	N. Y. Curb	1⅝	1⅜	1⅝	....	....
Replogle Steel	New York	15	13⅝	14⅛	....	....
Republic I. & S.	New York	60⅞	57⅞	59⅛	May, 1921	1.50
Republic I. & S. pfd.	New York	95	94	95	De.15, Ja.2, Q	1.75
Sloss-Sheffield S. & I.	New York	137½	131½	136½	De.10, De.21 Q	1.50
Sloss-Shef. S.&I. pfd.	New York	103	103	103	De.21, Ja.2, Q	1.75
U. S. Steel	New York	137	131⅞	135⅝	No.28, De.30 XQ	1.75
U. S. Steel pfd.	New York	126½	125⅝	126	No. 3, No. 28, Q	1.75
Virginia I. C. & C.	New York	....	....	43	Jan., 1924	1.50
Virginia I.C.&C.pfd	New York	....	....	77	De.15, Ja.2,	2.50
VANADIUM						
Vanadium Corp.	New York	32	31½	32	No.2, No.16 Q	0.50
ASBESTOS						
Asbestos Corp.	Montreal	96	93½	94	Se.30, Oc.15 Q	1.50
Asbestos Corp., pfd.	Montreal	116	115	115½	Se.30, Oc.15, Q	1.50
SULPHUR						
Freeport Texas	New York	20⅛	19⅜	20	Nov., 1919	1.00
Texas Gulf	New York	117⅝	115⅝	117⅝	De.1, De.15,QX	2.75
DIAMONDS						
De Beers Consol.	New York	28	27	28	Jy.27, Au.30	0.97
PLATINUM						
So. Am. Gold & P.	N. Y. Curb	5⅞	5⅞	5⅞	....	....
MINING, SMELTING, REFINING AND GENERAL						
Amer. Metal	New York	53⅝	52⅛	53⅛	No. 20, De. 1, Q	1.00
Amer. Metal pfd.	New York	116½	116½	116½	No. 21, De. 1, Q	1.75
Amer. Sm. & Ref.	New York	138	130½	137⅛	Oc.16, No.2, Q	1.75
Amer. Sm.&Ref.pfd.	New York	114¼	113¾	114¼	No.6, De.1, Q	1.75
Consol. M. & S.	N. Y. Curb	177	154	177	De.31, Ja.15	0.75
Federated Metals	N. Y. Curb	23½	22	22	....	....
Newmont Mining	N. Y. Curb	46⅞	46⅜	46⅜	De.31, Ja.15,	0.60
Southwest Metals	N. Y. Curb	....	....	2½	....	....
U. S. Sm. R. & M.	New York	48⅛	46⅜	47⅜	Oc.7, Oc.15, Q	0.75
U.S. Sm. R.&M.pfd.	New York	49¼	49¼	49¼	Oc.7, Oc.15, Q	0.87½

* Cents per share. † Bid or asked. Q, Quarterly. SA, Semi-annually. M, Monthly. K, Irregular. I, Initial. X, Includes extra. The first date given is that of the closing of the books; the second that of the payment of the dividend.

Boston quotations courtesy Boston Stock Exchange; Toronto quotations those of the Standard Stock Exchange of Toronto, by courtesy of Arthur E. Moysey & Co.; Spokane, Pohlman Investment Co.; Salt Lake, Stock and Mining Exchange and George H. Watson & Co.; Colorado Springs, Colorado Springs Stock Exchange.

LONDON QUOTATIONS, WEEK ENDED DECEMBER 12, 1925

	High	Low	Last	Date	Per Cent
Aramayo Mines (25 frs.)	83/9	77/6	77/6	Nov. 1925	5(c)
British Platinum	7/6	5/9	7/6	Feb. 1925	2½
Burma Corpn. (10 rupees)	18/10½	18/—	18/3	Aug. 1925	6 annas.
Bwana M'Kubwa	7/1½	6/9	7/—		
Camp Bird	6/—	5/3	5/6		
El Oro	5/9	5/4½	5/9	Nov. 1924	2½*
Esperanza	1/—	—/9	1/—		
Frontino & Bolivia	7/6	7/3	7/6	Jan. 1926	1½
Mexican Corporation	21/7½	19/9	21/3	Dec. 17	2/6
Mexican Mines of El Oro	37/6	35/—	36/3	Dec. 1925	12½*
Nechi (pref. 10s.)	2/6	2/—	2/—	1921-22	25
Oroville Dredging	3/9	3/6	3/9	Dec. 1923	3¾
Ouro Preto	2/9	1/3	2/6	May 1925	2½
St. John del Rey	10/10½	10/—	10/—	June 1925	6¼
San Francisco Mines	29/—	28/3	28/6	June 1925	15
Santa Gertrudis	21/4½	20/—	20/6	July 1920	5
Selukwe (2s. 6d.)	13/6	11/3	12/3	April 1917	6¾
S. American Copper	5/10½	5/3	5/6	Nov. 1917	75
Tanganyika	48/6	44/4½	45/7½	Sept. 1925	5
Tomboy	4/3	4/—	4/3	Sept. 1925	5
Union Minière du Haut-Katanga (Brussels) 100 Fr.	7.000	6.750	6.990	July 1925	150(b)

* Free of British income tax. (b) Belgian francs. (c) Swiss francs.